ERL

FLUKE®

Instruction Manual

Model

5200A

AC Calibrator

CGD - ERL

FLUKE®

Instruction Manual

Model

5200A

AC Calibrator

P/N 357194

Rev. 2 7/77

September 1975

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Rev. 12/77

Table of Contents

SECTION	TITLE	PAGE
1	INTRODUCTION AND SPECIFICATIONS	1-1
	1-1. INTRODUCTION	1-1
	1-10. SPECIFICATIONS	1-2
2	OPERATING INSTRUCTIONS	2-1
	2-1. INTRODUCTION	2-1
	2-3. SHIPPING INFORMATION	2-1
	2-6. INPUT POWER	2-1
	2-8. RACK INSTALLATION	2-1
	2-10. OPERATING FEATURES	2-2
	2-12. OPERATING NOTES	2-5
	2-14. AC Line Connection	2-5
	2-16. Load Connections	2-5
	2-22. Model 5200A to Model 5205A Connections	2-5
	2-24. Auxilary Outputs	2-5
	2-27. External (Remote) Sensing	2-7
	2-29. Ground Connections	2-7
	2-31. Guard Connections	2-7
	2-33. External Frequency Input	2-7
	2-35. Output Accuracy	2-8
	2-43. LOCAL OPERATION (MANUAL)	2-9
	2-44. Turn-On Procedure	2-9
	2-46. Amplitude Selection	2-9
	2-48. Frequency Selection	2-9
	2-50. Voltage Error Measurement	2-10
	2-52. REMOTE OPERATION	2-10

(continued on page ii)

TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
3	THEORY OF OPERATION	3-1
	3-1. INTRODUCTION	3-1
	3-3. SIMPLIFIED BLOCK DIAGRAM DESCRIPTION	3-1
	3-10. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION	3-3
	3-11. Oscillator	3-3
	3-14. Power Amplifier Assembly	3-3
	3-18. Attenuator Assembly	3-3
	3-23. AC/DC Converter Assembly	3-4
	3-27. Oscillator Control Assembly	3-4
	3-34. Reference Assembly	3-5
	3-39. CIRCUIT DESCRIPTION	3-5
	3-42. Motherboard PCB Assembly, A2	3-9
	3-44. Switch PCB Assembly, A3	3-9
	3-51. Power Supply Assembly, A5 (A5A1, A5A2 and A5A3)	3-10
	3-57. Attenuator Assembly, A6	3-11
	3-64. Power Amplifier Assembly, A7	3-12
	3-72. AC-DC Converter Assembly, A8	3-13
	3-78. Oscillator Control Assembly, A9	3-14
	3-88. Oscillator Assembly, A10	3-16
	3-92. Reference Assembly, A12	3-16
4	MAINTENANCE	4-1
	4-1. INTRODUCTION	4-1
	4-3. SERVICE INFORMATION	4-1
	4-6. GENERAL MAINTENANCE	4-1
	4-7. Cleaning Instructions	4-1
	4-9. Fuse Replacement	4-1
	4-11. Line Voltage Selection	4-1
	4-13. Lamp Replacement	4-2
	4-15. Access to the Mainframe PCB Assemblies	4-2
	4-17. Power Supply Motherboard Removal	4-2
	4-19. Front Motherboard Removal	4-4
	4-21. Access to the Switch PCB Assembly	4-4
	4-23. PERFORMANCE VERIFICATION CHECKS	4-4
	4-24. Introduction	4-4
	4-28. Equipment Set-Up	4-5
	4-30. Output Accuracy Test-Voltage Ranges	4-5
	4-36. Output Accuracy Test-Millivolt Ranges	4-7
	4-40. Frequency Output Test	4-9
	4-43. Distortion Tests	4-9
	4-46. Overload Test	4-9
	4-48. Load Regulation Verification Test	4-10
	4-50. Line Regulation Test	4-10

(continued on page iii)

TABLE OF CONTENTS, *continued*

SECTION	TITLE	PAGE
	4-52. Phase Lock	4-11
	4-54. Quadrature Output Test	4-11
	4-56. Voltage Error Control Test	4-12
	4-58. CALIBRATION PROCEDURES	4-12
	4-59. Introduction	4-12
	4-61. Equipment Preparation	4-12
	4-63. Power Supply Calibration	4-12
	4-65. Power Amplifier Bias Calibration.	4-13
	4-67. Special Calibrations	4-14
	4-75. Power Amplifier Zero Calibration	4-17
	4-76. Voltage Amplitude and Linearity Calibration	4-17
	4-83. Millivolt Amplitude Calibration	4-18
	4-85. Error Control Calibration	4-19
	4-87. TROUBLESHOOTING	4-19
	4-88. Troubleshooting Notes	4-19
	4-93. Troubleshooting Sequence	4-20
	4-95. Motherboard Assembly A2	4-20
5	**LIST OF REPLACEABLE PARTS**	5-1
	5-1. INTRODUCTION	5-2
	5-4. HOW TO OBTAIN PARTS	5-2
	5-7. USE CODE EFFECTIVITY	5-2
6	**OPTION AND ACCESSORY INFORMATION**	6-1
7	**GENERAL INFORMATION**	7-1
8	**SCHEMATIC DIAGRAMS**	8-1

List of Illustrations

FIGURE	TITLE	PAGE
1-1.	Equipment Dimensions	1-2
2-1.	Input Power Selection Switches, Location and Positions	2-2
2-2.	Front Panel Controls, Indicators and Terminals	2-2
2-3.	Rear Panel Connections	2-5
2-4.	Simple Load Connection (With Internal Sense)	2-5
2-5.	Calibrator Output Connectors, Pin Assignment	2-6
2-6.	External Sense Connections	2-7
2-7.	Guard Connections.	2-7
2-8.	Accuracy versus Output Connections	2-8
2-9.	Accuracy versus Harmonic Content	2-9
2-10.	Accuracy versus Low Order Odd Harmonic	2-9
3-1.	5200A Simplified Block Diagram	3-2
3-2.	5200A Functional Block Diagram	3-7
3-3.	Logic Signal Notation	3-9
3-4.	AC Sense Signal Processing	3-14
4-1.	PCB Assembly Locations	4-3
4-2.	Output Accuracy Test Equipment Configuration	4-6
4-3.	Output Accuracy Alternate Configuration	4-7
4-4.	Output Accuracy Millivolt Configuration	4-8
4-5.	Test Point and Adjustment Locations	4-13

(continued on page v)

LIST OF ILLUSTRATIONS, *continued*

FIGURE	TITLE	PAGE
4-6.	Labeled Adjustment Parts	4-15
4-7.	Phase Lock Calibration Configuration	4-17
5-1.	Dial Assembly View	5-4
5-2.	Front Panel View	5-6
5-3.	Interior View	5-8
5-4.	Readout Module View	5-10
5-5.	Assembled View	5-11
5-6.	PCB Assembly, Motherboard	5-13
601-1	Location of Address Matrix Card	601-1
601-2	RCU Mounting Location	601-2
601-3	Typical Serial Programming Connections	601-7
601-4	Typical Address Matrix Card Jumpers – Serial Program	601-9
601-5	Timing Requirements	601-10
601-6	Typical Address Matrix Card Jumpers – Parallel Program	601-12
601-7	RCU Serial Operation, Data Flow Diagram	601-13
601-8	RCU, Parallel Operation, Data Flow Diagram	601-15
605-1	IEEE Address Switches	605-2
605-2	IEEE Interface Block Diagram	605-5
8-1.	A2 Motherboard PCB Assembly (5200A-1010)	8-3
8-2	A3 Switchboard Assembly Component Location (5200A-1011)	8-4
8-3.	A3 Switchboard PCB Assembly (5200A-1011)	8-5
8-4.	A5 Power Supply Assembly Component Location (5200A-1020)	8-6
8-5.	A5 Power supply Assembly (5200A-1020)	8-7
8-6.	A6 Attenuator Assembly Component Location (5200A-1030)	8-8
8-7.	A6 Attenuator PCB Assembly (2 sheets) 5200A-1030)	8-9
8-8.	A7 Power Amplifier Assembly Component Location (5200A-1040)	8-12
8-9.	A7 Power Amplifier PCB Assembly (5200A-1040)	8-13
8-10.	A8 AC-DC Converter Assembly Component Location (5200A-1050)	8-14

(continued on page vi)

LIST OF ILLUSTRATIONS, *continued*

FIGURE	TITLE	PAGE
8-11.	A8 AC-DC Converter PCB Assembly (3 sheets) 5200A-1050)	8-15
8-12.	A9 Oscillator Control Assembly Component Location (5200A-1060)	8-20
8-13.	A9 Oscillator Control PCB Assembly (3 sheets) (5200A-1060)	8-21
8-14.	A10 Oscillator Assembly Component Location (5200A-1070)	8-26
8-15.	A10 Oscillator PCB Assembly (4 sheets) (5200A-1070)	8-27
8-16.	A11 Remote Control Unit Assembly Component Location (5200A-1080)	8-34
8-17.	A11 Remote Control Unit PCB Assembly (2 sheets) (5200A-1080)	8-35
8-18.	A12 Reference Supply Assembly Component Location (5200A-1090)	8-38
8-19.	A12 Reference Supply PCB Assembly (2 sheets)(5200A-1090)	8-39
8-20.	Inverter Assembly Component Location (5200A-1081)	8-42
8-21.	Inverter PCB Assembly (5200A-1081)	8-43
8-22.	A11 IEEE Interface (I/F) Assembly Component Location (5200-1686)	8-44
8-23.	A11 IEEE Interface (I/F) Assembly (2 Sheets) (5200-1086)	8-45

List of Tables

TABLE	TITLE	PAGE
2-1	Front Panel Controls, Indicators and Terminals	2-3
3-1	Attenuator PCB, Signal Path Summary	3-12
3-2	Frequency Range Relays	3-16
4-1	Test Equipment	4-4
4-2	Test Accessories	4-5
4-3	Output Voltage Accuracy Test Tolerances	4-6
4-4	Millivolt Ranges Output Accuracy Test Tolerances	4-8
4-5	Frequency Accuracy Test Tolerances	4-9
4-6	Distortion Test Settings and Tolerances	4-10
4-7	Load Regulation Test Values and Tolerances	4-11
4-8.	Main Program	4-21
4-9.	Switchboard Assembly A3	4-23
4-10.	Power Supply Assy. A5	4-28
4-11.	Attenuator Assembly A6	4-33
4-12.	Power Amplifier Assembly A7	4-36
4-13.	AC-DC Converter PCB Assembly, A8	4-44
4-14.	Oscillator Control Assembly A9	4-49
4-15.	Oscillator PCB Assembly A10	4-55
4-16..	Reference Assembly A12	4-59
4-17.	Standard Inside The Guard Regulator Voltages (Regulator Subassembly)	4-63
4-18.	Floating Inside the Guard Regulator Voltages (Regulator Subassembly)	4-63

(continued on page viii)

LIST OF TABLES, *continued*

TABLE	TITLE	PAGE
4-19.	Outside the Guard Regulator Voltages (Power Supply Subassembly)	4-63
4-20.	Power Supply R6 Replacement Values	4-63
4-21.	Attenuator Output and Sense Signal Paths - Operate Mode	4-64
4-22.	Power Amp and Attenuator Output and Substitute Sense Signal Paths–Standby Mode	4-64
4-23.	Attenuator Mode & Voltage Range Logic Inputs and Outputs	4-65
4-24.	Attenuator Frequency, Range Logic	4-65
4-25.	AC-DC Converter Buffer Amplifier Test Points	4-66
4-26.	Oscillator Control Assembly Test Points	4-66
4-27.	Oscillator Control Assembly HI-Freq. Roll off Compensator Checks	4-66
4-28.	Oscillator Control Frequency Range Test Points	4-67
4-29.	Oscillator Assembly Frequency Magnitude Switch Logic	4-68
5-1	Final Assembly	5-3
5-2	Motherboard, PCB Assembly, A2	5-12
5-3	Switch PCB Assembly, A3	5-14
5-4	Power Supply Mother PCB Assembly, A5	5-17
5-5	Power Supply PCB Subassembly, A5A1	5-19
5-6	Regulator PCB Subassembly, A5A2	5-21
5-7	Transformer PCB Subassembly, A5A3	5-24
5-8	Attenuator PCB Assembly, A6	5-25
5-9	Power Amplifier, PCB Assembly, A7	5-28
5-10	AC-DC Converter PCB Assembly, A8	5-35
5-11	Oscillator Control PCB Assembly, A9	5-42
5-12	Oscillator PCB Assembly, A10	5-51
5-13	Reference PCB Assembly, A12	5-59
600-1	5200A Accessories	600-1
601-1	Card-Edge Connector Pin Assignments	601-3
601-2	Frequency Range Coding	601-6
601-3	Amplitude Range Coding	601-6
601-4	Typical Byte Assignment for Serial Programming	601-8
601-5	Remote Control Option (–01) Parts List	601-14
601-6	Remote Control PCB Assembly, All, Parts List	601-16

(continued on page ix)

LIST OF TABLES, *continued*

TABLE	TITLE	PAGE
602-1	50-400 Hz Option (–02) Parts List	602-1
603-1	RCU Input Signal Inverter Option (–03), Parts List	603-2
605-1	Allowable Listen and Talk Addresses	605-2
605-2	Programming Instructions	605-3
605-3	Interrupt Codes	605-3
605-4	Voltage and Frequency Instructions	605-3
605-5	Serial Poll Status Byte	605-4
605-6	Status Message, Serial Poll Disabled	605-4
605-7	Troubleshooting	605-7
605-8	IEEE-488 Interface Option –05	605-11

Section 1

Introduction & Specifications

1-1. INTRODUCTION

1-2. The Model 5200A is a guarded, precision AC Calibrator designed for use in calibration laboratories and in manufacturing environments. The Calibrator provides accurate ac voltages from 100 μV to 120V rms, at currents up to 50 mA, and at frequenceis from 10 Hz to 1.2 MHz.

1-3. The amplitude of the output voltage is controlled by a range selector switch and six decade switches. Any of seven amplitude ranges (1mV, 10 mV, 100 mV, 1V, 10V, 100V, and 1000V) may be selected. (The 1000V range is used only in conjunction with a companion unit, the Model 5205A Precision Power Amplifier). The decade switches can then be set for any value from 10 to 120 percent of the selected range (each range has a 20 percent overrange capability). Six-digit resolution within the selected range provides steps as small as 1 nV in the 1 mV range through 100 μV in the 100V range (and 1 mV steps in the 1000V range). The amplitude can be offset up to either $\pm$0.3 percent or $\pm$3 percent (selectable) by means of a voltage error measurement feature. This feature provides direct indications of percentage error during calibration of voltmeters.

1-4. The frequency of the output voltage is similarly controlled by a range selector switch and four decade switches. Any of five frequency ranges (100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz) may be selected. The decade switches can then be set for any value from 10 to 120 percent of the selected range. Four-digit resolution within the selected range provides steps as small as 0.01 Hz in the 100 Hz range through 100 Hz in the 1 MHz range. If desired, the frequency can be phase-locked to an external reference source connected by coaxial cable to a BNC connector on the rear panel. The accuracy of the phase-lock feature is $\pm$1 degree (nominal).

1-5. The selected output of the 5200A is available at output connectors located on both the front and the rear panels. The front panel connectors are banana-type jacks and are provided for high and low output lines, high and low sense input lines, guard, and ground. The rear panel connectors are a pair of pcb card-edge connectors accessed through openings in the panel. One of the connectors provides interconnection to the Model 5205A Precision Power Amplifier (when used), and the other provides the selected calibrator output (except ground) to any other external equipment requiring it.

1-6. In addition to the regular calibrator outputs, a quadrature output and a counter output are available at BNC connectors on the rear panel. The quadrature output leads the regular output in phase by 90 degrees. The amplitude of the quadrature output is proportional to the setting of the amplitude control decade switches. Regardless of the range selected, the rms amplitude of this output will be anywhere from 1V, at minimum setting, to 12V, at maximum setting. At full-range (100 percent) setting, the amplitude will be 10V rms. The counter output is the same frequency as the other outputs, but in pulse form. The pulses are fixed in amplitude at +3V peak, and vary in width according to the selected frequency range.

1-7. Output overload protection is provided to limit output current. When an output overload occurs, the calibrator automatically enters the limit mode. When the normal load is restored, the calibrator automatically reverts to the operate mode.

1-8. All operating functions, except primary power switching and voltage error measurement, can be remotely programmed upon installation of the Remote Control Unit pcb assembly (–02 option). Programming requirements are

TTL compatible, or contact closures to ground. Connection of the programming control lines to the Remote Control Unit is by means of a card-edge connector accessed through an opening in the rear panel of the 5200A.

1-9. The 5200A may be bench or 19 inch rack mounted. (The overall dimensions of the unit are shown in Figure 1-1.) Input power requirements are 100, 115, 200, or 230V ac ±10 percent, 50 to 60 Hz, 150VA. A 50-to-400 Hz Input Power Modification (–02 option) is available to permit the unit to operate from 400 Hz, as well as 50– and 60– Hz, power lines.

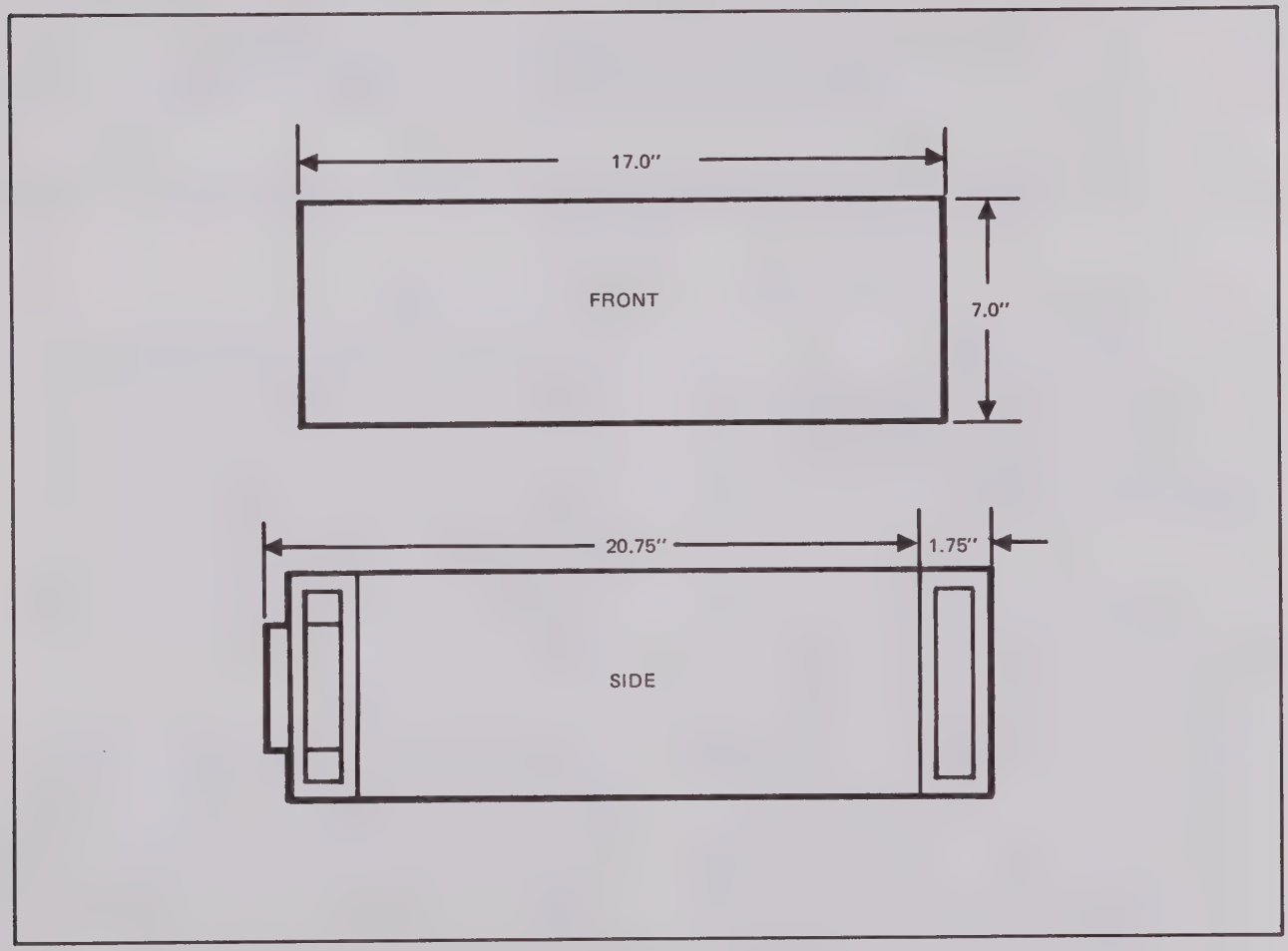


Figure 1-1. EQUIPMENT DIMENSIONS

1-10. SPECIFICATIONS

VOLTAGE RANGES
1 mV, 10 mV, 100 mV, 1V, 10V, 100V
(1000V with 5205A Power Amplifier)

Overrange
20% on all ranges (120V maximum)
(1100V with 5205A Power Amplifier)

Range Limits
10% to 120% (100 μV and above)

Resolution
0.0001% of Range (1 nV on 1-mV range)

FREQUENCY RANGES
100 Hz, 1 kHz, 10 kHz, 100 kHz, 1 MHz

Overrange
20% on all ranges (1.2 MHz maximum)

Range Limits
10% to 120% (10 Hz and above)

Resolution
0.01% of Range (.01 Hz on 100-Hz Range)
±0.1% of Range (100 kHz Range)
±1.0% of Range (1MHz Range)

ACCURACY
(for 90 days, 23 ±5°C, after 1-hour warmup.)

Amplitude

10 Hz to 30 Hz

± (0.1% of setting +0.005% of range)
1, 10, 100 volt ranges.

± (0.1% of setting +10 μV
1, 10, 100 millivolt ranges.

30 Hz to 20 kHz

± (0.02% of setting +0.002% of range)
1, 10, 100 volt ranges.

± (0.02% of setting +10 μV)
1, 10, 100 millivolt ranges.

20 kHz to 100 kHz

± (0.05% of setting +0.005% of range)
1, 10, 100 volt ranges

± (0.05% of setting +20 μV
1, 10, 100 millivolt ranges.

0.1 MHz to 1 MHz

± (0.33% of setting +0.03% of range)
1, 10, 100 volt ranges.

± (0.33% of setting +30 μV)
1, 10, 100 millivolt ranges.

Frequency

100-Hz to 100-kHz Ranges	±(1% of setting +0.1% of range)
1-MHz Range	±(3% of setting +0.3% of range)

SHORT TERM AMPLITUDE STABILITY

1-mV to 100V Ranges:

The change in rms value will be less than (0.007% of setting +0.0003% of range) p-p for the 1 kHz thru 1 MHz ranges and 0.004% p-p of range for the 100 Hz range over a 10 minute interval.

LONG TERM AMPLITUDE STABILITY
(At Constant Line, Load and Temperature)

±0.005% of setting for 24 hours

±0.01% of setting for 6 months

FREQUENCY STABILITY

±0.05% for 24 hours

±0.1% for 6 months

AMPLITUDE LIMITS WITH TEMPERATURE
(0° to 18°C and 28°C to 50°C)

Add ±(0.025 x accuracy) per °C to stated accuracy limits

FREQUENCY LIMITS WITH TEMPERATURE
(0° to 18°C and 28°C to 50°C)

Add ±(0.025 of setting) per °C to stated accuracy limits

MAXIMUM OUTPUT CURRENT (For Rated Accuracy)

50 mA rms from 10% to 120% of range

NOTE: Min. Load impedance for specified accuracy:

1-, 10-, 100-mV Ranges	*6kΩ*
1V Range	*50Ω above .1 MHz*

CURRENT LIMIT

The output is protected against overloads and short circuits by a current limiter.* Upon removal of the overload, the output will recover automatically.

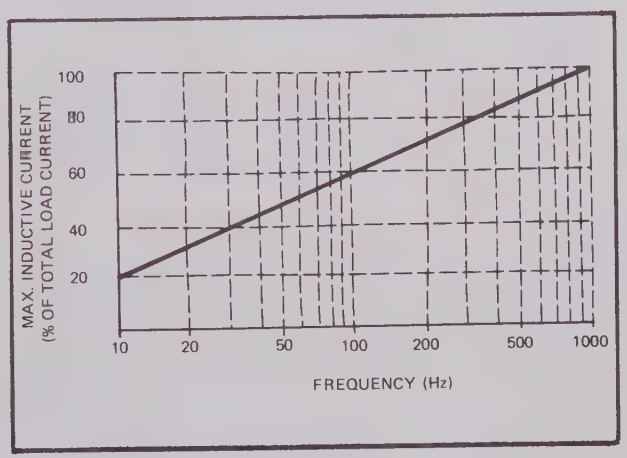
**NOTE:* *See MAX. INDUCTIVE LOAD.*

MAXIMUM CAPACITIVE LOAD

1000 pF

MAXIMUM INDUCTIVE LOAD

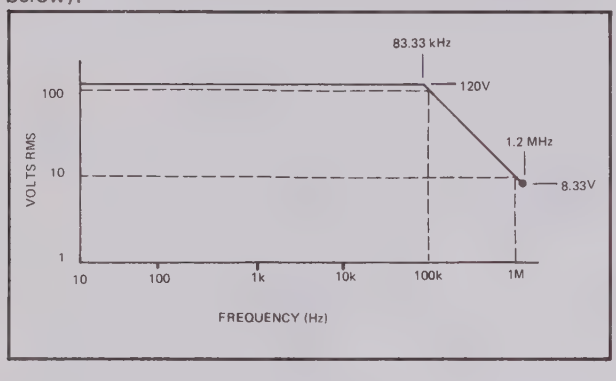
Maximum inductive current allowed is shown below.



The above limit does not restrict the use of precision inductive dividers that have a maximum voltage limit of (0.35 x frequency) or higher.

MAXIMUM OUTPUT VOLTAGE

120V rms, up to 83.33 kHz. Beyond that, maximum output voltage decreases as frequency increases. At highest frequency (1.2 MHz), maximum output voltage is 8.33V rms. Maximum volt-hertz product is 1.0×10^7 or $1.0 \times 10^7 \times$ (Voltage Range/10), whichever is less (See graph below).



RESPONSE TIME

For any programmed amplitude, the output voltage and frequency will settle to within 0.01% of change as follows:

10 Hz - 30 Hz	4 to 15 seconds
30 Hz - 100 Hz	4 seconds
100 Hz - 400 Hz	2 seconds
400 Hz - 1 MHz	1 second*

The output will recover from short circuits and overload conditions within the specified settling time.
*Typically below 0.5 seconds from 400 Hz to 1.2 MHz except for frequency range changes.

TOTAL HARMONIC DISTORTION AND LINE RELATED NOISE

(Bandwidth 10 Hz to 10 MHz) Effects of broadband noise included in accuracy specification for both RMS and average responding instruments.

10 Hz to 100 kHz. . . 0.04% of setting +10 μV rms *†

100 kHz to 500 kHz . . 0.3% of setting +30 μV rms

500 kHz to 1 MHz . . 1% of setting +30 μV rms

**For output currents exceeding 15 mA, see below:*
†The specification on the 1-Volt range between 10 Hz and 15 Hz is 0.08% of setting + 10uV rms.

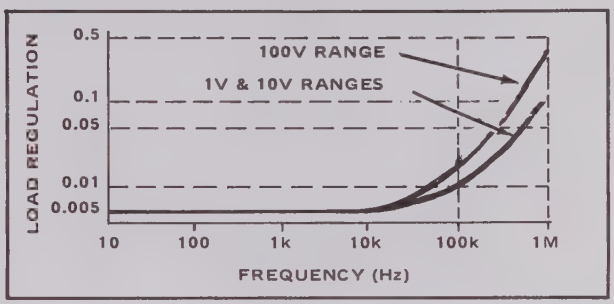
20 kHz to 100 kHz

$$\left[0.04 + \left(\frac{0.3}{V}\right)\left(\frac{F}{100}\right)\left(\frac{I}{50}\right)^2\right] \%$$

V = volts, F = kHz, I = mA

LOAD REGULATION

0.005% of selected range, no load to full load, up to 10 kHz. Beyond that, regulation is a function of both range and frequency selected (See following graph).



NOTE: Output impedance on the 1-mV through 100-mV ranges in less than 1.5Ω in series with 1.5 μH.

LINE REGULATION

±0.001% of setting for a 10% change in line voltage.

EXTERNAL FREQUENCY PHASE LOCK INPUT

The oscillator of the 5200A has the capability of being phased locked to an external signal. Phase lock accuracy is ±3° below 30 Hz, and ±(1° + 0.05° per kHz) over a ±2% band around the center frequency, (BNC connector on rear panel). Input is 1 volt to 10 volts rms (useable down to 100mV rms).

QUADRATURE OUTPUT

(Minimum Load Z = 3 kΩ)

Amplitude

10V rms ±10% when 100% of range is selected. Quadrature amplitude is proportional to the dialed output voltage from 10% to 100% of Range. (BNC connector on rear panel.)

Phase

90° ±(1° + 0.03° per kHz), 40 Hz to 1.2 MHz.
90° ± 3°, 10 Hz to 40 Hz

COUNTER OUTPUT

Auxiliary frequency counter output (BNC Connector) on rear panel; 3V pulse, short circuit protected.

EXTERNAL SENSE

A two powition switch is provided to control Internal or External Sensing on the 1V, 10V, and 100V ranges. When in Remote Sense (1, 10 and 100V ranges) and the sense leads are accidently disconnected, the output voltage will not exceed the programmed setting by more than 2.0 volts.

VOLTAGE ERROR MEASUREMENT

0 to ±0.3% with 0.001% resolution

0 to ±3% with 0.01% resolution

An "OFF" error switch position is provided to easily lock out the error measurement function which is automatically disabled in program mode.

OUTPUT TERMINALS

High, Low, High Sense, Low Sense, Guard, and Ground terminals on front and rear panels. Front panel terminals are five-way binding post. Rear panel terminals are pins of a pcb card-edge connector, with mating connector supplied (P/N 337675).

LOCAL/REMOTE OPERATION

Two-position CONTROL switch, interlocked with the optional remote programming function. In the LOCAL position, all control is implemented from the front panel switches. In the REM position, control is obtained via the programming lines through a rear panel connector. When the REMOTE function is called on the programming line, the 5200A will be locked in the Remote condition (regardless of the position of the CONTROL switch), disabling the error measurement control and all other front panel controls except the POWER switch. When the LOCAL function is called on the programming line, the 5200A may be operated in either the Local or the Remote condition, at the operator's discretion.

SAFETY FEATURES

When the ac power is turned on, the instrument is automatically set to the Standby condition. When in Remote Sense and the sense leads are accidentally disconnected, the output voltage will not exceed 2.0 volts above the programmed setting on the 1V thru 100V ranges. The 1 mV thru 100 mV ranges are not affected.

CALIBRATION REQUIREMENTS

The 5200A is calibrated at the factory by instrumentation traceable to the Naional Bureau of Standards. Periodic calibration of the 1V, 10V, and 100V ranges may be accomplished through the use of a thermal transfer standard and a precision dc source, such as the Fluke Models 540B and 332D. The accuracy on the 1-, 10-, and 100 mV ranges depends on precision inductive dividers which are tested at the factory with special verification equipment, and do not require periodic adjustment. All other adjustments can be made with general purpose laboratory equipment.

GENERAL

Input Power

100, 115, 200, 230V ac ± 10% (switch selectable), 50 to 60 Hz (50-to-400-Hz Option available, 150 VA.

Maximum Isolation Voltages

500V dc or peak ac, "Guard" to "Chassis"
100V dc or peak ac, "Lo" to "Guard"

Dimensions

7" (178 mm) x 17" (432 mm) x 21.75" (533 mm)

Weight

53 pounds (24 kg)

ENVIRONMENTAL

Cooling

Forced air cooled. Air intake through re-useable filter on rear panel. Air exit along both sides.

Temperature

0°C to 50°C, operating
−40°C to +75°C, storage

Relative Humidity

0 to 80 percent (0°C to +40°C)
0 to 70 percent (+40°C to +50°C)

Shock

15G, 11-ms half-sine wave

Vibration

3.1G, 10 Hz to 55 Hz

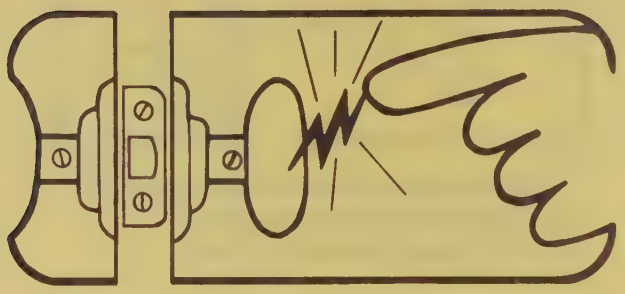
Altitude

0 to 10,000 feet, operating
50,000 feet, non-operating

static awareness

A Message From

John Fluke Mfg. Co., Inc.

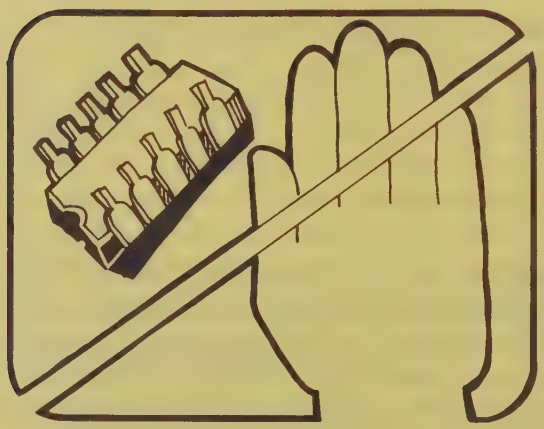


Some semiconductors and custom IC's can be damaged by electrostatic discharge during handling. This notice explains how you can minimize the chances of destroying such devices by:

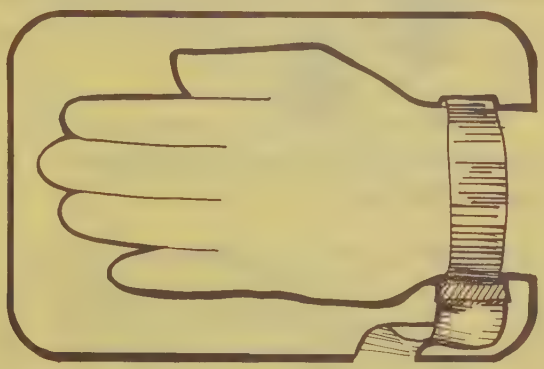
1. Knowing that there is a problem.
2. Learning the guidelines for handling them.
3. Using the procedures, and packaging and bench techniques that are recommended.

The Static Sensitive (S.S.) devices are identified in the Fluke technical manual parts list with the symbol "⊗".

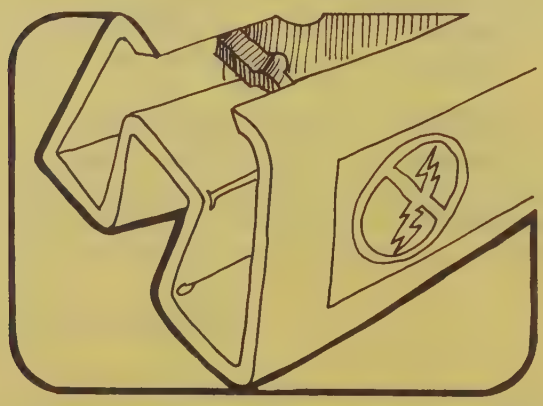
The following practices should be followed to minimize damage to S.S. devices.



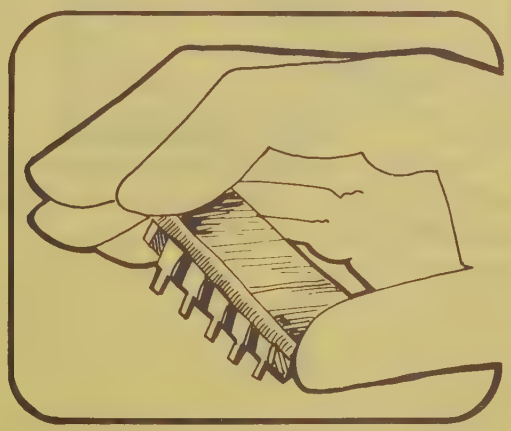
1. MINIMIZE HANDLING



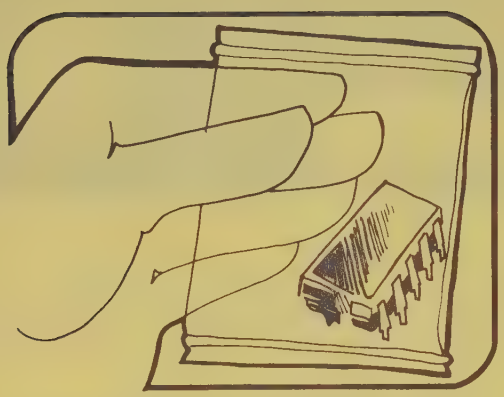
3. DISCHARGE PERSONAL STATIC BEFORE HANDLING DEVICES



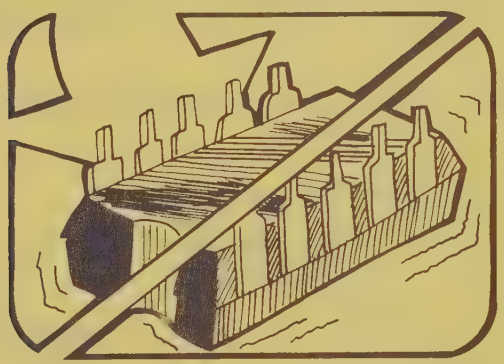
2. KEEP PARTS IN ORIGINAL CONTAINERS UNTIL READY FOR USE.



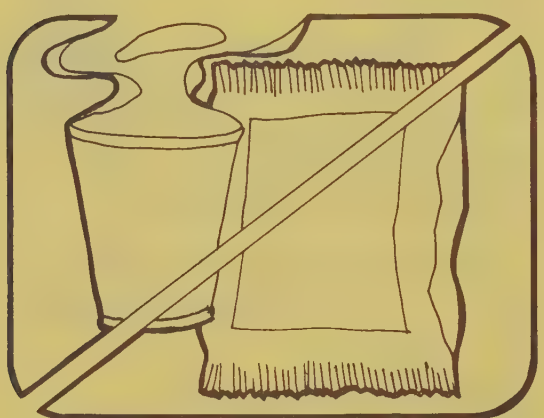
4. HANDLE S.S. DEVICES BY THE BODY



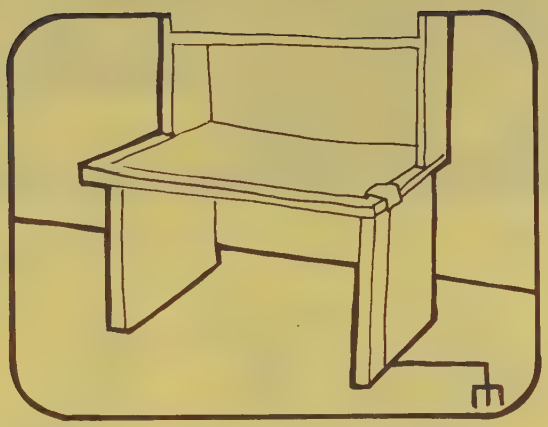
5. USE ANTI-STATIC CONTAINERS FOR HANDLING AND TRANSPORT



6. DO NOT SLIDE S.S. DEVICES OVER ANY SURFACE



7. AVOID PLASTIC, VINYL AND STYRAFOAM IN WORK AREA



8. HANDLE S.S. DEVICES ONLY AT A STATIC-FREE WORK STATION

9. ONLY ANTI-STATIC TYPE SOLDER-SUCKERS SHOULD BE USED.

10. ONLY GROUNDED TIP SOLDERING IRONS SHOULD BE USED.

Anti-static bags, for storing S.S. devices or pcbs with these devices on them, can be ordered from the John Fluke Mfg. Co., Inc.. See section 5 in any Fluke technical manual for ordering instructions. Use the following part numbers when ordering these special bags.

John Fluke Part No.	Bag Size
453522	6" x 8"
453530	8" x 12"
453548	16" x 24"
454025	12" x 15"

Section 2
Operating Instructions

2-1. INTRODUCTION

2-2. This section contains information regarding installation and operation of the Model 5200A AC Calibrator. It is recommended that the contents of this section be read and understood before any attempt is made to operate the calibrator. Should any difficulties arise during operation, please contact your nearest John Fluke Sales Representative or the John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043; telephone (206) 774-2211. A list of Sales Representatives is located in Section 7 of this manual.

2-3. SHIPPING INFORMATION

2-4. The Model 5200A is packaged and shipped in a foam-packed container. Upon receipt of the equipment, a thorough inspection should be made to reveal any possible shipping damage. Special instructions for inspection and claims are included in the shipping carton.

2-5. If reshipment of the equipment is necessary, the original container should be used. If the original container is not available, a new container can be obtained from the John Fluke Mfg. Co., Inc. Please reference the equipment model number when requesting a new shipping container.

2-6. INPUT POWER

2-7. The 5200A can be operated from a 100, a 115, a 200 or a 230V ac, 50 to 60 Hz, power line. (Installation of the –02 option permits operation from a 400 Hz power line.) Before connecting the equipment to primary power, check and, if necessary, set the input power selection switches as follows:

a. Remove the top dust cover.

b. Remove the inner cover located in the right section (as viewed from the top front).

c. Locate the input power selection switches shown in Figure 2-1.

d. Set the two slide switches to accomodate the local line voltage. The different switch position combinations are printed on the printed circuit board.

e. Replace the inner and top dust covers.

f. Install the proper fuse (i.e. 1½A slo-blo for 100 and 115 vac, and ¾A slo-blo for 200 Vac line voltage) in the rear panel fuse holder.

2-8. RACK INSTALLATION

2-9. The 5200A is designed for bench-top use or for installation in a standard 19 inch equipment rack using the optional Accessory Rack Mounting Kit (part number M07-205-600). Accessory chassis slides (part number M00-208-610) can also be installed to better facilitate access to the rack-installed equipment. Information regarding installation of the mounting accessories is given in Section 6, Rack Installation subsection.

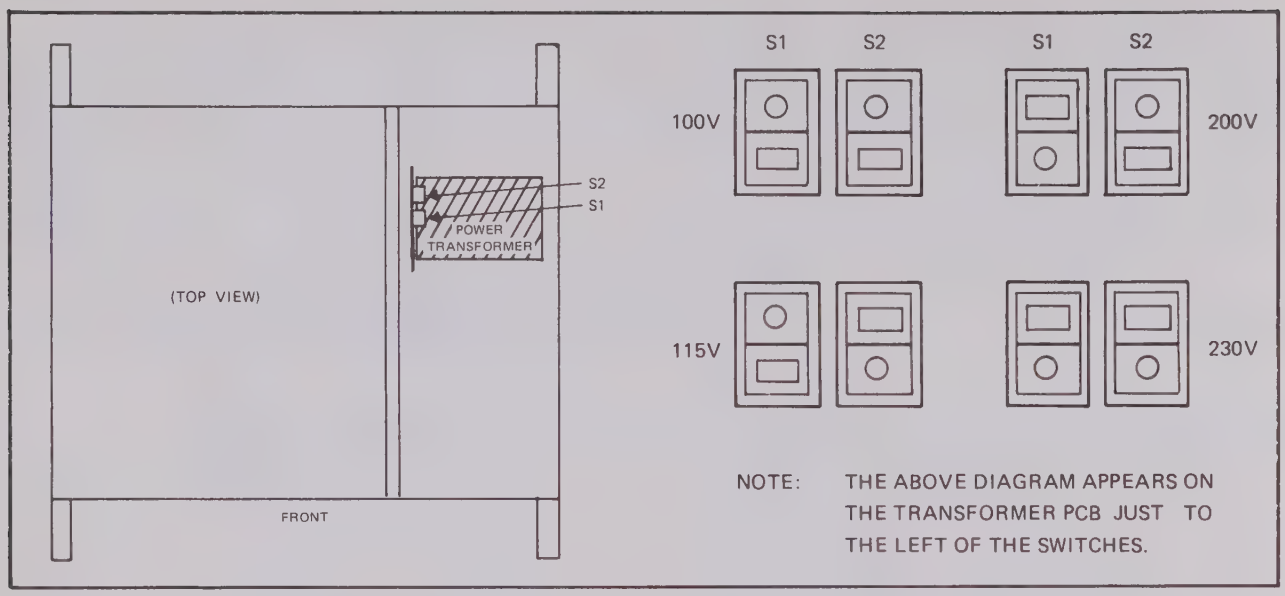


Figure 2-1. INPUT POWER SELECTION SWITCHES, LOCATION AND POSITIONS.

2-10. OPERATING FEATURES

2-11. The front panel controls, indicators and terminals are shown in Figure 2-2. The items shown are listed in numerical order in Table 2-1, together with the name and function of each.

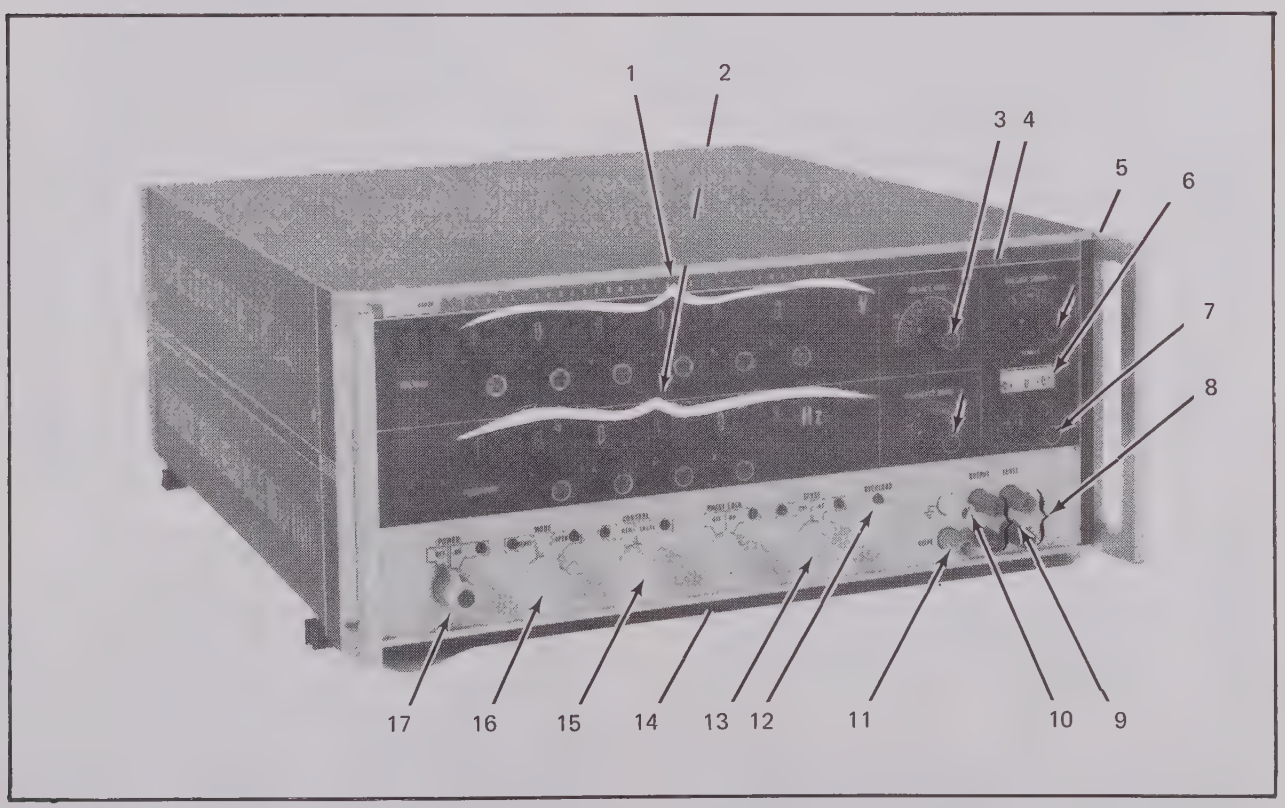


Figure 2-2. FRONT PANEL CONTROLS, INDICATORS AND TERMINALS

Table 2-1. FRONT PANEL CONTROLS, INDICATORS AND TERMINALS.

FIG. & INDEX NO.	NAME	FUNCTION
2-2, 1	VOLTAGE Selection Switches	Select desired calibrator output voltage (within range selected by VOLTAGE RANGE switch). Position of each switch is displayed in window above switch; windows form a readout that displays selected voltage. Leftmost switch has 11 positions (.1 thru 1.1 range) to provide 20% overrange; rest of switches have 10 positions (0 thru 9).
2	FREQUENCY Selection Switches	Select desired calibrator output frequency (within range selected by FREQUENCY RANGE switch). Operation of switches in same as VOLTAGE selection switches (direct readout of selected frequency, and 20% overrange capability).
3	VOLTAGE RANGE Switch	Selects desired output voltage range. Controls decimal point location in VOLTAGE readout. Also controls prefix for unit of measurement (window to left of "V" will be blank or have the prefix "m", depending upon range selected).
4	FREQUENCY RANGE-Hz Switch	Selects desired output frequency range. Controls decimal point location in FREQUENCY readout. Also controls prefix for unit of measurement (window to left of "Hz" will be blank or have either "K" or "M" for a prefix, depending upon range selected).
5	VOLTAGE ERROR —% Switch	Enables voltage error measurement feature and selects multiplier for VERNIER scale indication. When in X1 position, indication is read directly; when in X.1 position, indication must be multiplied by 0.1 (divided by 10). *NOTE: If the switch is left in the error position the error selected by the switch and dial positions are automatically entered on all outputs.*
6	VERNIER Scale	Indicates voltage error of instrument under test in percent of selected calibrator output, when voltage error measurement feature is enabled and instrument under test is brought to proper indication by VERNIER ± control. Highest graduations are ±3.0, subject to selected multiplier.
7	VERNIER ± Control	Adjusts output of calibrator up to ±3% when voltage error measurement feature is enabled, bringing instrument under test to proper indication, in order to determine amount of voltage error.
8	SENSE HI, SENSE LO Terminals	Provide front panel connection to sense inputs for external sensing (1V, 10V and 100V ranges only).
9.	OUTPUT HI, OUTPUT LO terminals	Provide front panel connection to calibrator output.
10	⏚ (Ground) Terminal	Provides front panel connection to chassis, and to earth ground when power cord is properly connected. Refer to paragraph 2-30.
11	GUARD Terminal	Provides front panel connection to internal guard shield and is used to reduce effects of common-mode voltages. Refer to paragraph 2-32.

Table 2-1. FRONT PANEL CONTROLS, INDICATORS AND TERMINALS (Contd.)

FIG. & INDEX NO.	NAME	FUNCTION
2-2, 12	OVERLOAD Indicator	Lights to indicate overloaded calibrator output, and remains lit until overload condition is removed.
13	SENSE Switch and Indicators	Selects desired sensing mode: INT . . . . . Enables internal sensing mode (local sensing); sensing takes place at the output of Attenuator Assembly, A6. EXT . . . . . Enables external sensing mode (remote sensing); sensing takes place at load, when sensing leads are connected between load and SENSE terminals. (Can only be selected on V ranges; on mV ranges, internal sensing is automatically selected.) Indicator for selected sensing mode lights.
14	PHASE LOCK Switch and Indicator	Switches phase lock feature on and off. When in ON position, causes oscillator to phase-lock to external reference signal applied to appropriate rear panel BNC connector. Refer also to paragraph 2-34. Indicator lights when phase lock is switched on. *NOTE: If the PHASE LOCK Switch is ON and no phase reference signal is present the output frequency will be at the lower end of the search pattern.*
15	CONTROL Switch and Indicators	Selects desired calibrator control mode: REM . . . . . Places calibrator in remote control mode by enabling remote interface (Option –01) and inhibiting front panel controls, except for POWER switch. LOCAL . . . . . Places calibrator in local control mode by enabling front panel controls. Indicator for selected control mode lights.
16	MODE Switch and Indicators	Selects the desired calibrator operating mode: STDBY . . . . . Places calibrator in standby mode by removing selected output voltage from output terminals. OPER . . . . . Places calibrator in normal operating mode. If the 1000V range is selected but a 5205A is not connected the mode switch will not go into operate. Indicator for selected operating mode lights. *NOTE!* *The calibrator automatically reverts to standby after a 30 second warm-up delay when power is initially applied.*
17	POWER Switch and Indicator	Switches calibrator on and off. Indicator lights when power is switched on.

2-12. OPERATING NOTES

2-13. The following paragraphs describe various conditions which should be considered before operating the 5200A.

2-14. AC Line Connection

2-15. The input power cord plug is a three-prong polarized connector which permits connection to any of the power line voltages described in paragraph 2-6. Ensure that the round pin is connected to a high quality earth ground. The 5200A is energized by means of the front panel POWER switch.

2-16. Load Connections

2-17. Connection of the load (i.e. the voltmeter or other device or system using the calibrator output) to the 5200A may be made at the front panel, or at either of two rear panel connectors. The front panel connectors are shown in Figure 2-2; the rear panel connectors are shown in Figure 2-3.

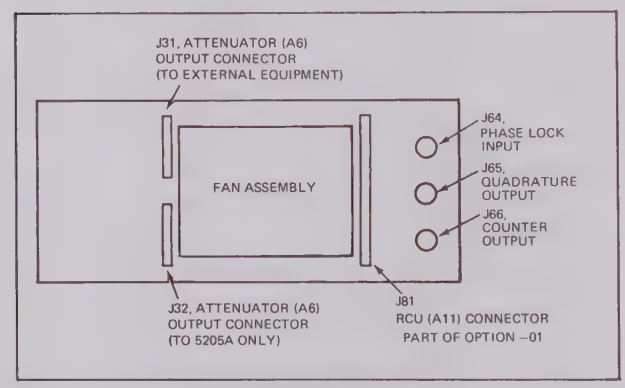


Figure 2-3. REAR PANEL CONNECTORS

2-18. FRONT PANEL

2-19. Front panel terminals permit connection of the load in several different configurations as shown in Figures 2-4, 2-6 and 2-7. Figure 2-4 shows a simple load connection with neither sensing or guarding (from common mode voltages). Sense connections are described in paragraph 2-27 and guard connections are described in paragraph 2-31.

2-20. REAR PANEL

2-21. A pair of printed circuit board edge connectors is accessible through openings in the rear panel when the cover plates are removed. The lower connector (shown in Figure 2-3) provides connection to the companion Model 5205A Precision Power Amplifier as described in paragraph 2-22,

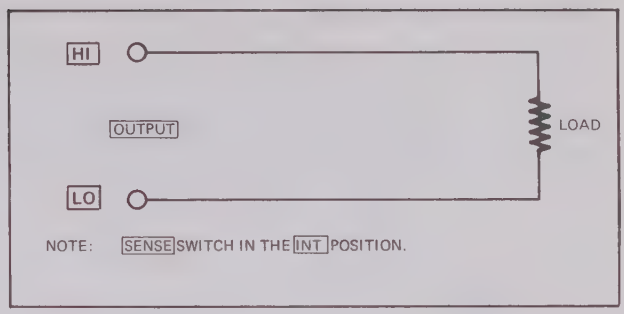


Figure 2-4. SIMPLE LOAD CONNECTION (WITH INTERNAL SENSE).

while the upper connector provides the calibrator output to any other external equipment by means of a user-supplied cable and a 5200A - 4103 connector assembly. The pin assignments of the printed circuit board output connector are shown in Figure 2-5 and should be referenced when constructing the interconnecting cable. If the guard feature is to be used, the interconnecting cable must be shielded. Refer also to the guard connection information contained in paragraph 2-31, and the sense connection information contained in paragraph 2-27.

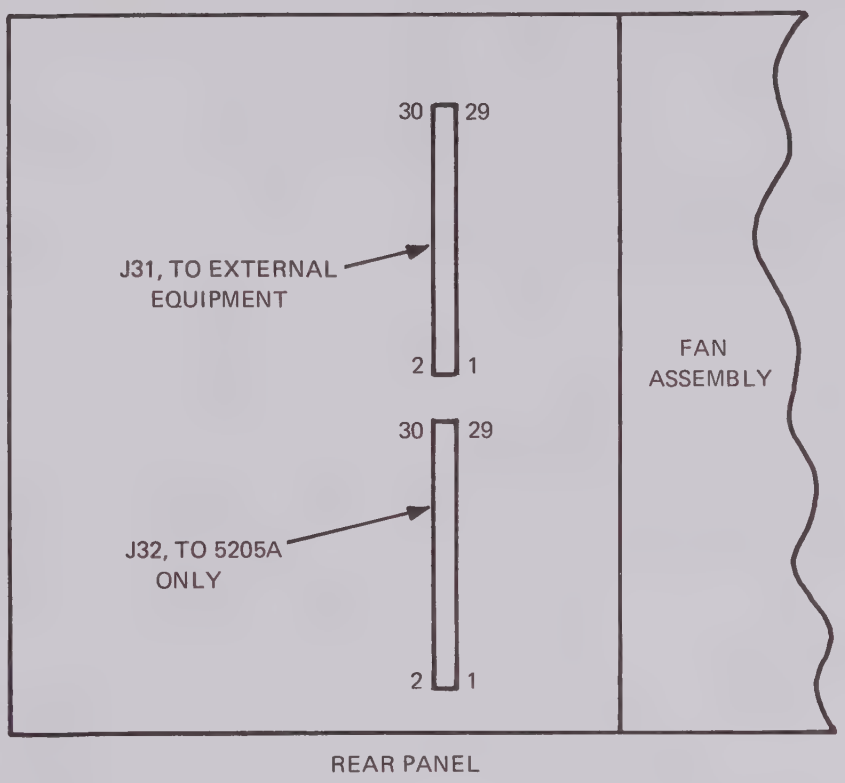
2-22. Model 5200A-to-Model 5205A Connections

2-23. The 5205A Precision Power Amplifier operates with the 5200A to extend its output range of voltage and current. Connection of the 5200A output to the 5205A input is made by means of a cable assembly (part number 341560) which mates with the lower printed circuit board on the rear panel of the 5200A and the 25-pin connector on the rear panel of the 5205A.

2-24. Auxiliary Outputs

2-25. The 5200A is equipped with a pair of auxiliary outputs which appear at BNC connectors on the rear panel as shown in Figure 2-3. The upper connector provides a signal which leads the fundamental (main) output by 90 degrees and which has an amplitude proportional to that of the selected fundamental output. This output (quadrature) has a maximum amplitude of 10V rms, $\pm 10\%$ when the VOLTAGE decade switches are set to 100 percent of any selected amplitude range, and is reduced proportionally to 1V at the 10 percent setting.

2-26. A second auxiliary output provides a 3 volt pulse signal for application to an external frequency counter. The counter output is short-circuit protected and appears at a BNC connector shown in Figure 2-3.



J31		J32	
PIN NO.	FUNCTION	PIN NO.	FUNCTION
2	GUARD CONNECTION	1	5205A STANDBY STATUS
19	SENSE INPUT–LOW	3	5205A CONTROL
22	CALIBRATOR OUTPUT–LOW	5	+5V RETURN
27	SENSE INPUT–HIGH	7	+5V SUPPLY
29	CALIBRATOR OUTPUT–HIGH	11	5205A OPERATE COMMAND
		15	5205A OVERLOAD TRIP
		21	GUARD CONNECTION
		23	5205A SENSE–HIGH
		25	5205A INPUT–HIGH
		27	5205A INPUT–LOW
		29	5205A SENSE–LOW

Figure 2-5. CALIBRATOR OUTPUT CONNECTORS, PIN ASSIGNMENT

2-27. External (Remote) Sensing

2-28. When a load is connected to the calibrator output, and when the IR drop across the output leads is significant, the rated accuracy of the calibrator is available at the load if external sensing is used. High and low sense terminals and connectors are provided for this purpose, on the front panel output and on both of the rear panel outputs, and may be used when operating in the 1V, 10V and 100V ranges only. (Internal sensing is automatically selected on all three mV ranges, regardless of the position of the SENSE switch.) Polarities must be matched with the output terminals. Figure 2-6 shows a typical calibrator output connection using the external sense feature, but not the guard feature.

CAUTION!

When the external sense function is not being used, the front panel SENSE switch must be in the INT position in order to prevent higher-than-selected output voltages.

2-29. Ground Connections

2-30. A ground terminal is provided at the front panel output. The ground terminal is connected directly to the equipment chassis and to earth ground via the power cord. Note that no connection to chassis is provided at the two rear panel Attenuator output connectors.

2-31. Guard Connections

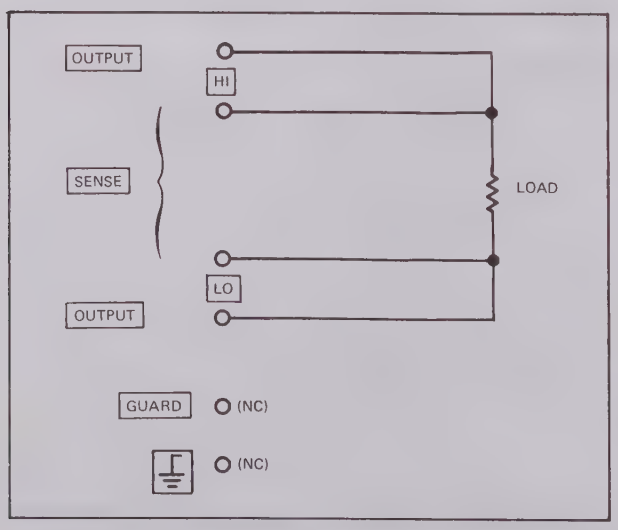


Figure 2-6. EXTERNAL SENSE CONNECTIONS

2-32. The calibrator is equipped with a guard shield that isolates its internal circuitry from the chassis and earth ground. Guard terminals and connectors are provided at the front panel and both rear panel calibrator outputs, and when used, greatly reduce errors caused by common-mode voltages. A typical connection of a load to the calibrator output using the guard and remote sense features is shown in Figure 2-7.

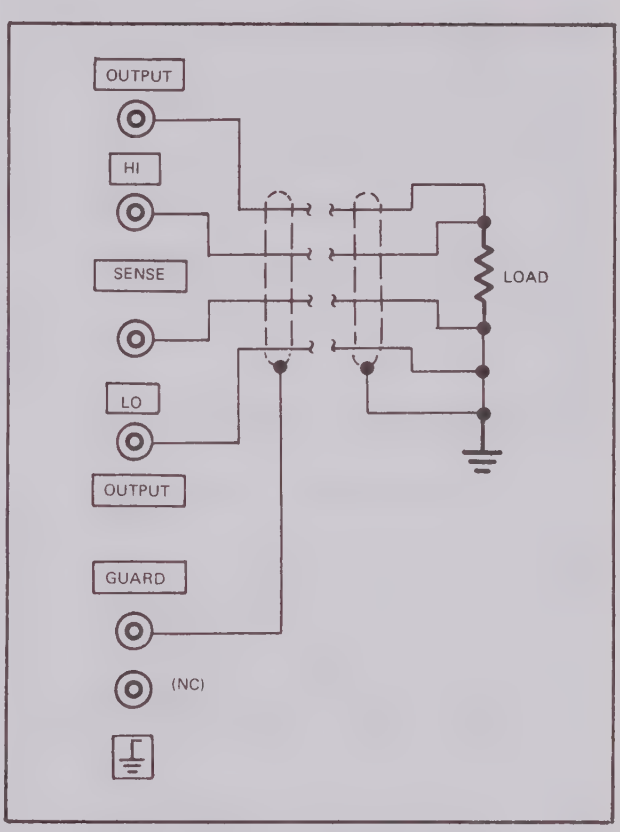


Figure 2-7. GUARD CONNECTIONS

2-33. External Frequency Input

2-34. The output frequency of the 5200A can be phase-locked to an external reference input signal if they are within ±2% of each other. The external reference signal should be between 1V and 10V rms, sine wave or square wave. Connection of the external reference signal is made to the calibrator by means of the BNC connector shown in Figure 2-3.

NOTE!

If the PHASE LOCK switch is ON and no phase reference signal is present, the output frequency will be at the lower end of the search pattern.

2-35. Output Accuracy

2-36. Following are some guidelines and comments that should help the operator to achieve the best possible calibration results when using the 5200A.

2-37. ACCURACY VERSUS OUTPUT CONNECTIONS

2-38. The mV output ranges of the 5200A are derived through precision step-down transformers from the 1V range, where internal sensing at the input to the transformers is employed to ensure accuracy. These low-level outputs are floating, with provision for guarding them from low-frequency (power line, primarily) ground loop currents. Because of the extremely low level of the mV outputs, and the fact that external sense cannot be used, it is necessary to exercise care when calibrating mV measuring instruments. Many of these instruments are ac-line operated, and nearly all of the broadband instrument inputs are referenced to chassis ground. Generally speaking, the optimum connections for low-level calibrations when using the mV ranges of the 5200A are as shown in Figure 2-8.

2-39. Due to the finite output impedance in the mV ranges (< 1.5Ω in series with 1.5 uH), the 5200A accuracy is specified for load impedances greater than 6 kΩ. A typical millivoltmeter has an input resistance of 1 MΩ, in parallel with about 30 pF . Below 100 kHz, up to 3 feet of coax cable (RG-58) will not cause significant error. When operating on the 1 MHz range, at specifically 1 MHz, the 30 pF of the millivoltmeter input alone represents 5-kΩ reactance. Therefore, the length and type of connecting cable may significantly affect accuracy at the higher frequencies.

2-40. ACCURACY VERSUS DISTORTION AND NOISE.

2-41. The 5200A amplitude accuracy statement refers in all instances to the rms value of the output which is, ideally a pure sine wave. The distortion and noise specifications characterize the contaminants to the sine wave output in the frequency band from 10 Hz to 10 MHz. Within this band, the calibration of an rms-sensing meter is straightforward, and the output accuracy statement may be taken at face value since it refers to the rms value. The mV outputs of the 5200A, operating in the 1-MHz range, contain some low energy noise with Fourier components above 10 MHz. These are created by transients occuring for a very small fraction of the period of the output waveform. Assuming that these sources represent a 1 percent contribution (on a continuous-sine-wave basis), it is apparent that the rms output is affected less than 0.005%. (See Figure 2-9).

2-42. Calibrating an average-responding, rms-indicating meter in the presence of these low-energy components presents no problem since they have such a low average value referred to the period of the primary output waveform. Of more concern are the low-order harmonic components; specifically, the odd harmonics, since even harmonics are ignored by an average detector for the levels to be discussed. Odd harmonics can cause reading errors on average detecting instruments which are proportional to (1/Harmonic No.) x rms value (Harmonic). (See Harmonic 3 Figure 2-10 for multiplier.) Harmonics through the 9th are included in the distortion and noise specification passband of 10 MHz for 5200A outputs up to 1 MHz. Effects of the 11th and higher order elements (which are excluded from the specification) are attenuated by more than 90 percent of their respective rms values. Finally, since the transients appearing in the 5200A mV output occur near the sine wave zero crossing, they will have no effect on peak-detecting instruments.

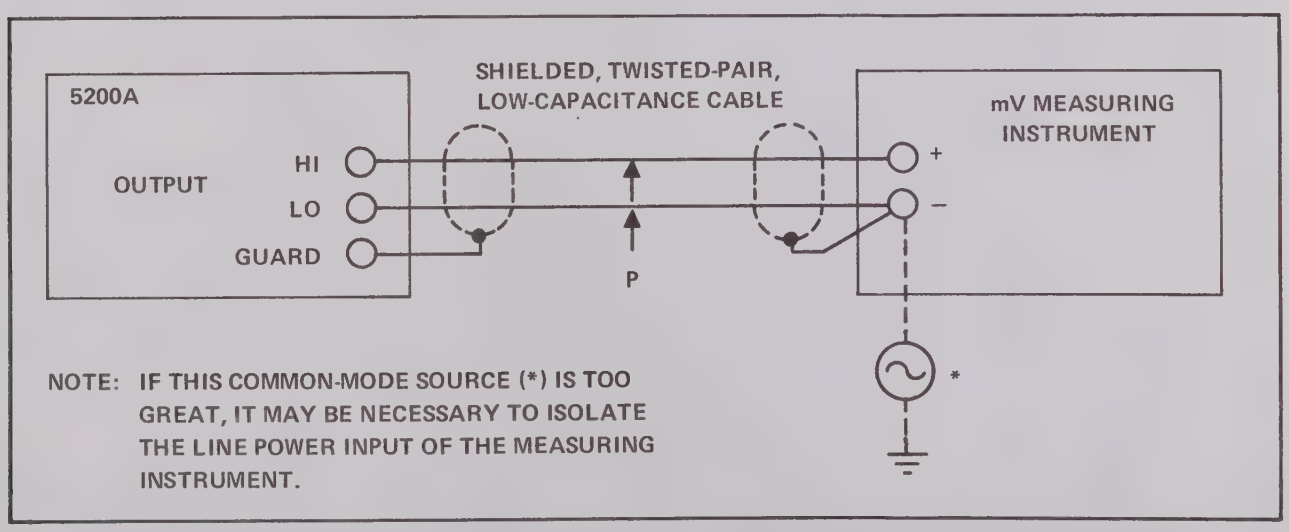


Figure 2-8. ACCURACY VERSUS OUTPUT CONNECTIONS

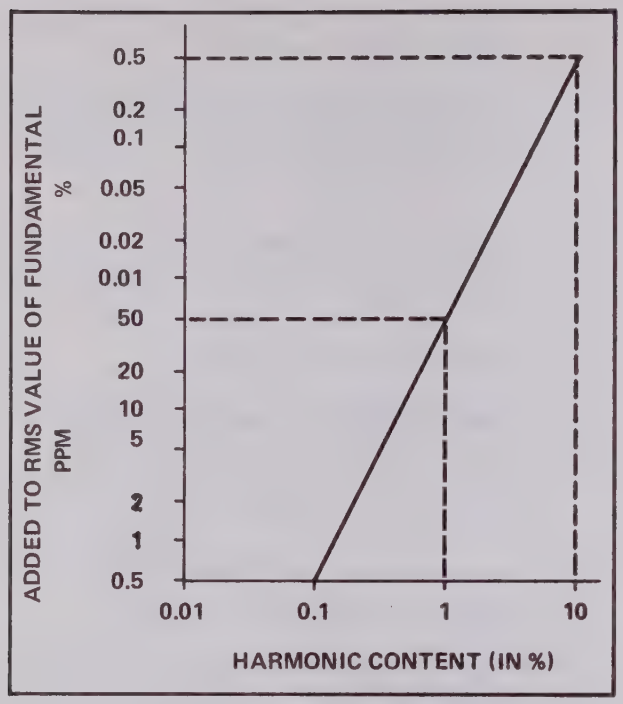


Figure 2-9. ACCURACY VERSUS HARMONIC CONTENT

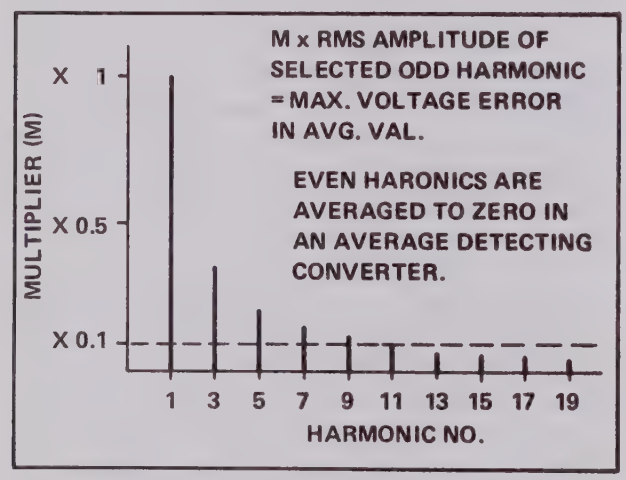

MULTIPLIER (M)
X 1
X 0.5
X 0.1
M x RMS AMPLITUDE OF SELECTED ODD HARMONIC = MAX. VOLTAGE ERROR IN AVG. VAL.
EVEN HARONICS ARE AVERAGED TO ZERO IN AN AVERAGE DETECTING CONVERTER.
1 3 5 7 9 11 13 15 17 19
HARMONIC NO.

Figure 2-10. ACCURACY VERSUS LOW-ORDER ODD HARONICS

2-43. LOCAL OPERATION (MANUAL)

NOTE!

If it is desired, prior to operation of the calibrator, to verify its performance against the specifications listed in Section 1, refer to the calibration procedure presented in Section 4.

2-44. Turn-On Procedure

2-45. Use of the following procedure is suggested for initial turn-on of the equipment, and for familiarization with the controls and indicators. With reference to the previous paragraphs, turn-on the 5200A as follows:

a. Ensure that the proper input power switching is selected (Refer to paragraph 2-7).

b. Connect the calibrator to ac power.

c. Make all necessary load and sense connections.

d. Set the CONTROL switch to LOCAL.

e. Set the PHASE LOCK and SENSE switches as required.

f. Set the POWER switch to ON. Observe that the OVERLOAD lamp lights for five to ten seconds.

CAUTION!

If the OVERLOAD lamp remains lit for more than 30 seconds, turn power off and refer to the troubleshooting procedures presented in Section 4.

g. Momentarily set the MODE switch to OPER to energize the output.

NOTE!

The 5200A assumes the standby mode after a 30 second warm-up delay when power is initially applied.

h. If it is desired to verify operation of the calibrator, connect a suitable scope across the load and select several values of frequency and amplitude while observing the results on the scope.

2-46. Amplitude Selection

2-47. Manual amplitude selection of the calibrator output is performed using the front panel VOLTAGE decade switches shown in Figure 2-2. (The CONTROL switch must be set to LOCAL in order to control the 5200A from the front panel.) The minimum selectable output amplitude is 100 μV rms. The maximum selectable output amplitude is 119.9999V rms, or 1199.999V rms when used in conjunction with the 5205A Precision Power Amplifier. The VOLTAGE RANGE switch provides the necessary range selection.

2-48. Frequency Selection

2-49. Manual frequency selection of the calibrator output is performed using the front panel FREQUENCY de-

cade switches shown in Figure 2-2. (The CONTROL switch must be set to LOCAL in order to control the 5200A from the front panel.) Five frequency ranges provide outputs of 10 Hz to 1.1999 MHz. The FREQUENCY RANGE - Hz switch provides the necessary range selection. When used with the 5205A Precision Power Amplifier, the output signal meets specification only to 100 kHz.

NOTE!

If the PHASE LOCK switch is on and no phase reference signal is present, the output frequency will be at the lower extreme of the phase lock capture range (typically 4% below the selected output frequency).

2-50. Voltage Error Measurement

2-51. In the local mode of control (only), the 5200A can be used to measure the amount of voltage error (expressed as a percentage of the output) present in a voltmeter under calibration. To measure voltmeter error, proceed as follows:

a. Set the MODE switch to STDBY.

b. Set the VOLTAGE ERROR - % switch to X.1.

c. Set the VOLTAGE RANGE and the FREQUENCY RANGE - Hz switches to the desired ranges.

d. Set the VOLTAGE and the FREQUENCY decade switches to the desired values.

e. Connect the voltmeter under measurement to the calibrator output using one of the previously described methods of connection.

f. Select the proper voltage range on the voltmeter to correspond with the calibrator output selected in steps c and d.

g. Set the MODE switch to OPER.

h. Adjust the VERNIER control to obtain an indication on the voltmeter that corresponds to the selected calibrator output voltage. (If necessary, set the VOLTAGE ERROR - % switch to X1.)

i. Read the amount and polarity of voltmeter error directly from the VERNIER scale.

j. Return the VOLTAGE ERROR - % switch to OFF.

2-52. REMOTE OPERATION

2-53. Remote operation of the 5200A is controlled by an external programming source when the calibrator is equipped with the –01 Option. Refer to Section 6 of this manual for remote programming information used with this option.

Section 3
Theory of Operation

3-1. INTRODUCTION

3-2. This section contains the theory of operation for the Model 5200A. The theory is presented first in a simplified block diagram description, followed by a functional block diagram description, then in a schematic-level circuit description. A complete set of schematic diagrams is contained in Section 8 of this manual.

3-3. SIMPLIFIED BLOCK DIAGRAM DESCRIPTION

3-4. The main function of the Model 5200A is to generate an ac voltage which can be precisely selected over wide ranges of frequency and amplitude. (The accuracy and stability of the output voltage and frequency are listed in the specifications contained in Section 1.) Output sensing of the amplitude is provided, either at the load or the calibrator output, so that the calibrator operates as a closed-loop control system and provides accurate output voltages over a wide range of loads and selected amplitudes.

3-5. A simplified block diagram of the 5200A is presented in Figure 3-1. The ac signal source is a double-integrator type oscillator. The oscillator output is selectable over a wide range of frequencies by means of the front panel switches, and is fed to the input of a Power Amplifier. The Power Amplifier provides the gain necessary to accommodate the two higher amplitude ranges (not counting the 1000V range), and feeds the Attenuator which accommodates the four lower amplitude ranges. The Attenuator output connects the selected ac signal to the load, which can be converted to either the front panel or the rear panel connectors.

3-6. In order to maintain precise control of the output amplitude, the calibrator operates as a closed-loop control system using output sense connections to complete the loop. The sense connections are made at either the load or the Attenuator output, and feed the sense signal back into the calibrator via a high-impedance input within the AC-DC Converter. The ac sense signal is converted to a proportional dc value by a wideband rectifier contained in the AC-DC Converter. The dc sense signal is then compared (summed) with an amplitude reference voltage of the opposite polarity and a difference (error) voltage is produced to adjust the oscillator amplitude to the proper value.

3-7. The amplitude reference voltage is produced within the calibrator as a result of the amplitude selector switch settings. That is, the Reference Assembly interprets the settings of the front panel amplitude switches and generates a corresponding reference voltage. The reference voltage is compared to the dc sense voltage and any error voltage produced by the integrator is fed to the Oscillator Control Assembly. The Oscillator Control Assembly, in turn, uses the error voltage (amplitude control voltage) to control the amount of feedback voltage to the Oscillator.

3-8. The action of the described control loop is such that when a different output amplitude is selected, a change in amplitude reference voltage (produced by the Reference Assembly) results. Since the sense input has not yet changed and the dc sense voltage is compared with the changed amplitude reference voltage, a resulting amplitude control voltage (error voltage) is fed to the Oscillator Control Assembly. The Oscillator Control Assembly uses the amplitude control voltage to adjust the oscillator amplitude in the proper direction. When the calibrator output reaches the selected amplitude, the dc sense voltage (at the wideband rectifier output) becomes balanced with the amplitude reference voltage, and no error voltage is produced. At this point, the Oscillator Control Assembly ceases to alter Oscillator amplitude.

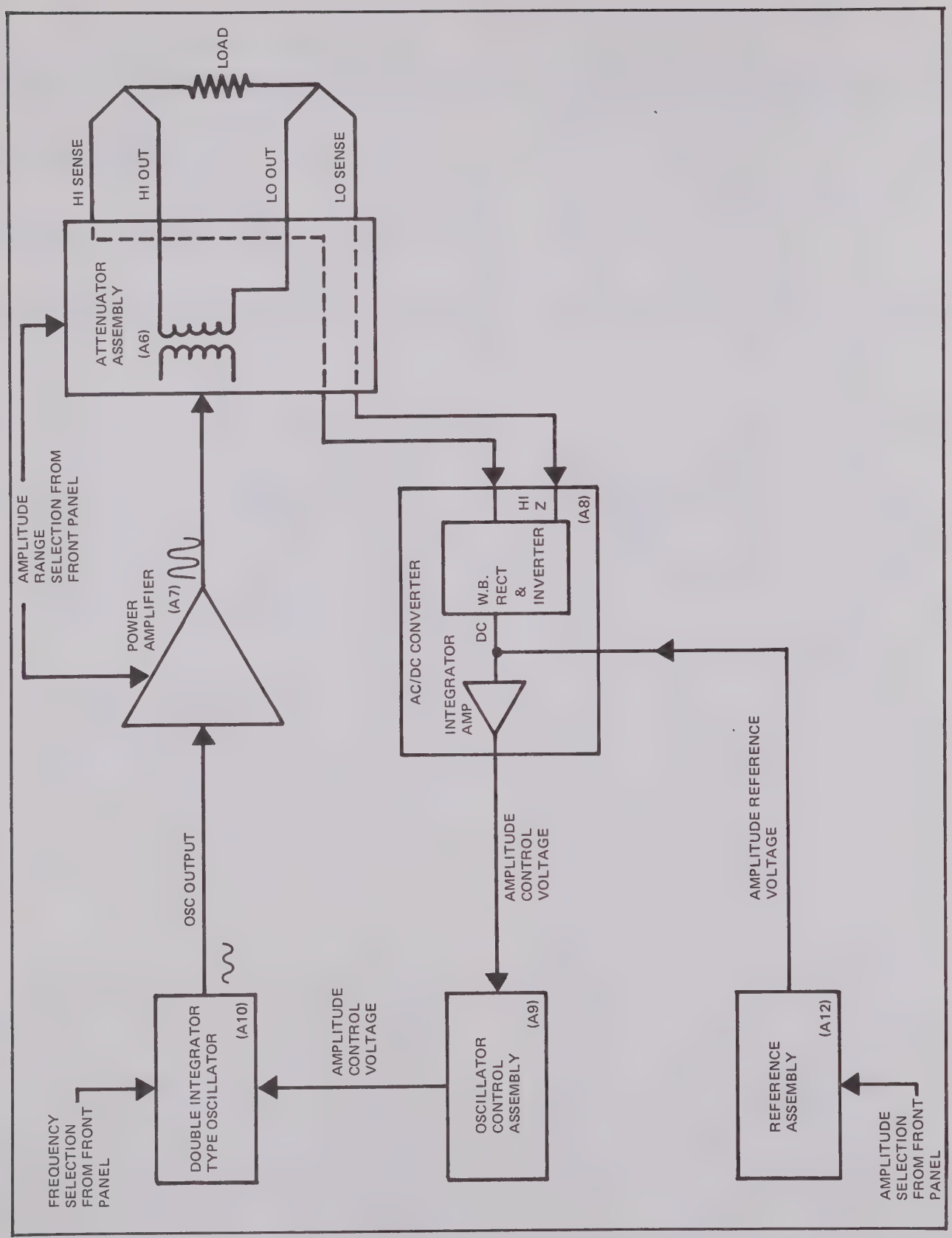


Figure 3-1. 5200A SIMPLIFIED BLOCK DIAGRAM

3-9. The Oscillator Control Assembly controls oscillator amplitude over a 12:1 range. Amplitude range selection is provided by the two selectable gain values of the Power Amplifier and several settings of the attenuator. Frequency and frequency range selection are made by switching selected values of R and C within the Oscillator. In addition, all front panel amplitude and frequency selection switches (except for the error measurement feature) can be duplicated by a remote programming source when option −01 is installed in the calibrator.

3-10. FUNCTIONAL BLOCK DIAGRAM DESCRIPTION

3-11. Oscillator

3-12. The heart of the 5200A is a double-integrator type, RC oscillator contained in the Oscillator Assembly (A10) and shown in Figure 3-2. (Figure 3-2 is a block diagram of the 5200A which shows the functional elements.) The Oscillator comprises a summing amplifier, a quadrature amplifier, an oscillator amplifier and their associated resistors and capacitors. The quadrature and oscillator amplifiers, in conjunction with their frequency, select resistors and frequency range select capacitors, form a pair of integrators, each providing a phase shift of 90 degrees; or a total phase shift of 180 degrees. The output of the oscillator amplifier is fed back through a resistor (R1) into the summing amplifier, which provides an additional 180 degrees of phase shift by means of signal inversion. The result of the combined phase shifts around the loop is approximately 360 degrees at all frequencies. As a result, the loop is on the verge of sustaining oscillation at a frequency that yields unity gain. It needs only the parallel, electronically controlled feedback paths on the Oscillator Control pcb to bring the combined loop phase shifts to exactly 360 degrees and thus sustain oscillation at the selected frequency.

3-13. The oscillator frequency is controlled over a 12:1 range by switching values of the frequency select resistors at the inputs of the quadrature and oscillator amplifiers. The range of frequencies is controlled by the frequency range select capacitors (located on the oscillator control assembly) whose values are switched in accordance with the desired frequency range. The switching of the oscillator frequency select resistors is accomplished entirely by means of FET swtiches, and the switching of the frequency range capacitors is accomplished with reed relays. Both are controlled by either the front panel switches or the Remote Control Unit.

3-14. Power Amplifier Assembly

3-15. The Power Amplifier accepts the 0.33 to 4.0V rms output of the Oscillator and provides the gain necessary to obtain attenuator inputs of 1.0 to 120V rms. The Power Amplifier has two fixed gain settings of 3 and 30; the latter is used only on the 100V range.

3-16. As shown in Figure 3-2, the Oscillator output signal is fed to the negative side of the Power Amplifier input stage, while the positive side is connected to the output of a low-drift dc amplifier. The purpose of the low-drift dc amplifier is to compensate for any dc offset voltages developed within the Power Amplifier, which result in an error at the output. Since the output is fed back via R1/R2 and R4 to the dc amplifier, and the output of the amplifier feeds the positive side of the input stage, any dc voltage appearing at the Power Amplifier output is compensated for. That is, any error on the negative side of the input stage is matched on the positive side by the dc amplifier, resulting in a net dc error at the assembly output of zero.

3-17. The mid-stage of the Power Amplifier drops the dc operating point of the amplified oscillator output to -190V dc and provides voltage gain. The output stage operates in conjunction with a bootstrap amplifier to produce the 1-to-120V rms output to the attenuator. The function of the bootstrap amplifier is to eliminate the need to connect the output stage directly across the +190-volt and −190-volt regulated supplies by allowing the stage to float between these potentials. The low voltages produced by zener diodes CR8 and CR9 provide the necessary collector voltages for the output transistors, in place of the 190-volt supplies.

3-18. Attenuator Assembly

3-19. Since the output of the Power Amplifier is always greater than 1V rms, the Attenuator is necessary in order to obtain calibrator outputs in the range of 0.1 to 1000 mV rms. Figure 3-2 shows that the Attenuator assembly inserts a series of ratio transformers into the calibrator output when operated in the 1-mV, 10-mV, 100-mV and 1V ranges. For operation in the 10-volt and 100-volt ranges, the ratio transformers are bypassed. When operating in the 100V range, the Power Amplifier has a gain of 30 so that the input to the Attenuator is in the range of 10 to 120V rms, depending upon the front panel amplitude selection. For all other amplitude ranges, the Power Amplifier has a gain of 3, resulting in an Attenuator input of 1 to 12V rms.

3-20. Three ratio transformers are used to provide an output for any of the four lower ranges that is flat over the entire frequency range of the calibrator. The transformers have a primary-to-(full) secondary step-down ratio of 10:1, to accommodate the 1V range. The secondary winding of each transformer is also tapped to provide step-down ratios of 100:1, 1000:1 and 10,000:1 to accommodate the 100mV, the 10mV and the 1mV ranges, respectively. Switching within the Attenuator selects the correct tap on the correct transformer in accordance with the front panel amplitude range selection, and connects that tap to the calibrator output.

3-21. The Attenuator also provides the necessary division or attenuation of the sense input signal. When operating in the 1-, 10- and 100-volt ranges, the sensing may be internal within the calibrator, or external at the load. In the 1-volt range, the sense signal is taken directly from the load or calibrator output with no attenuation required for application to the AC-DC Converter Assembly. In the 10-volt range, the sense signal is inductively divided by a factor of 10; and in the 100-volt range, the sense signal is resistively divided by a factor of 100.

3-22. On the 1-, 10- and 100- millivolt ranges, sensing is always internal and is derived from the ratio transformers used in these ranges to step down the power amplifier output to a level suitable for application to the AC-DC Converter. Since the ratio transformers are fixed, the outputs which supply the sense signal are proportional to the amplitude of the calibrator output, and are in the range of 0.1 to 1.2V rms as required by the AC-DC Converter assembly. External sensing cannot be provided in the three lowest ranges due to the 0.1 to 1.2V rms sense input requirement of the AC-DC Converter assembly.

3-23. AC-DC Converter Assembly

3-24. The AC-DC Converter produces an amplitude control voltage for use by the Oscillator Control assembly, which is derived from the sense signal input and a selected reference input. (The reference input is produced as a result of front panel amplitude selection, and is described in paragraph 3-34.) As shown in Figure 3-2, the 0.1 to 1.2V rms sense signal is fed to the buffer amplifier within the AC-DC Converter. The buffer amplifier has a high impedance input to minimize IR drop in the sense leads. The output of the buffer amplifier is fed to a wideband rectifier for conversion to a proportional dc value. The rectifier is a multi-path operational amplifier which rolls off at 6 dB per octave from 0.001 Hz to 150 MHz, and is equipped with a pair of diodes in the feedback paths.

3-25. The dc output of the rectifier is summed with a variable reference voltage (dc) produced by the Reference assembly in accordance with the front panel amplitude selection switches. The rectifier output is of the opposite polarity to the variable reference, and when the two are in the proper ratio to each other, the input to the high-gain integrator amplifier is zero and the output is constant. If either the dc sense signal or the variable reference voltage changes value, the integrator amplifier output amplitude control voltage changes accordingly, and the Oscillator Control assembly, in turn, adjusts the amplitude of the Oscillator in the proper direction and by the required amount. In this manner, the servo action of the amplitude control loop adjusts the Oscillator amplitude in response to load changes and amplitude selection changes.

3-26. The input to the integrator is also directly affected by selection of the amplitude least significant digit. Front panel (or remote) selection of the least significant amplitude digit adds or subtracts positive voltage to or from the integrator input, resulting in an adjustment of amplitude control voltage. The other five amplitude digits adjust the oscillator control voltage by means of the Reference Assembly.

3-27. Oscillator Control Assembly

3-28. The two main functions of the Oscillator Control assembly are to adjust the amplitude of the Oscillator output in accordance with a negative amplitude control voltage from the AC-DC Converter, and to keep the Oscillator output in phase with some external reference frequency when that feature is used. Oscillator amplitude control is a function of feedback from the output of the quadrature amplifier (contained in the Oscillator assembly) to the input of the summing amplifier, effecting an adjustment in phase shift around the loop to provide a means of oscillator amplitude adjustment.

3-29. As shown in Figure 3-2, the quadrature amplifier output is fed from the Oscillator assembly to the y-input of an analog multiplier (U3) contained in the Oscillator Control assembly. The ouput of the multiplier is fed to the input of the summing amplifier to control the oscillator output amplitude in accordance with the x-input of the multiplier. The x-input of the multiplier (U3) is derived from the negative amplitude control voltage (produced by the AC-DC Converter) after comparison with the peak output of the oscillator quadrature amplifier. The comparison of the quadrature amplifier output to the amplitude control voltage creates a secondary control loop, and is provided for by a diode switch operated indirectly by the Oscillator output signal.

3-30. The Oscillator output signal is fed to a zero-crossing detector. The zero-crossing detector operates to produce an output pulse whenever the Oscillator output passes through zero while going from negative to positive (i. e., once each cycle). Since quadrature amplifier output is 90 degrees out of phase with the oscillator output, the zero crossing pulses close the diode switch for a brief period of time when the quadrature amplifier output is at its peak. The quadrature amplifier output and the negative amplitude control voltage (from the AC-DC Converter) are both fed to the input of a dc amplifier preceding the diode switch. As a result, the diode switch supplies a signal to the succeeding integrator whenever the peak quadrature amplifier output is different from the negative amplitude control voltage. The integrator output is connected to the x-input of the analog multiplier to control the amplitude of the oscillator accordingly.

3-31. The action of this secondary control loop is such that any change in the amplitude control voltage causes an output from the integrator next time the diode switch closes. The integrator output causes the analog multiplier to adjust the amplitude of the oscillator output in accordance with the change in oscillator control voltage. This control loop operates within the previously described main control loop which employs the sense input and the AC-DC Converter assembly.

3-32. The Oscillator Control assembly also provides for the phase-lock feature of the calibrator. The external phase-lock input is squared-up and applied to one input of a phase detector. The second input of the phase detector is derived from a one shot multivibrator triggered by the zero-crossing detector. The one shot supplies a pulse to the phase detector which compares the phase relationship of the oscillator output and the external phase-lock reference signal. The phase detector produces an output proportional to their difference, which is summed with the other inputs to the summing amplifier. The phase detector provides a slight adjustment of oscillator loop gain, and thus provides a small amount of frequency control.

3-33. The action of the phase-lock loop is such that any phase difference between the Oscillator output and phase-lock reference input results in a proportional phase detector output. The output of the phase detector is summed with the other Oscillator inputs, and adjusts the total Oscillator feedback by an amount necessary to bring about synchronism with the reference phase lock input.

3-34. Reference Assembly

3-35. The Reference Assembly receives the amplitude selection information (except for the least significant digit) from the front panel switches (or from the Remote Control Unit) and generates a corresponding dc reference voltage used to control the calibrator output amplitude. The output of the Reference assembly is referred to as the Variable Reference signal, and is fed to the AC-DC Converter where it is compared with the rectified AC Sense signal to control the Oscillator amplitude.

3-36. To generate the Variable Reference signal, which is proportional to the selected output amplitude, a 10-MHz clock is employed to drive a digital counter. The counter divides the clock signal by a factor of 1.3×10^5, and all counter outputs are fed (in parallel) to one set of inputs on a digital comparator. The other set of inputs to the digital comparator is supplied by the front panel switches (or by the Remote Control Unit). The comparator accepts both sets of inputs, and when the counter reaches the same state as selected on the front panel amplitude switches, produces a "compare" output. The compare output pulse sets a flip-flop which by means of FET switches, removes the output of a 7-volt reference supply from the input of a five-pole, active filter, and replaces it with a ground.

3-37. When the counter reaches full count and wraps around to zero, a pulse is fed into the clear input of the flip-flop. When the flip-flop is cleared, it changes state to open the ground connection and connect the 7-volt reference supply to the active filter. The result of the opening and closing of the fet switches is the generation of dc pulses at the active filter input. The duty cycle of the pulses is determined by the timing of the compare signal, which is determined by the setting of the front panel amplitude switches. The active filter removes all ac components from this pulse train, leaving a dc average voltage proportional to the pulse duty cycle. The averaged dc voltage is applied to the integrator within the AC-DC Converter.

3-38. The Reference assemlby also provides the error measurement feature. Error measurement is made by slightly adjusting the 7-volt reference supply in either direction. Since the Variable Reference signal is derived from the 7-volt supply, and also controls calibrator output amplitude, adjustment of the supply results in adjustment of the calibrator output amplitude.

3-39. CIRCUIT DESCRIPTION

3-40. The following paragraphs present a circuit description of each pcb assembly within the 5200A. The schematic diagrams referenced are located at the very back of the manual. Without the Inverter Assembly (−03 Option). the 5200A interfaces with external equipment on a negative-active basis. That is, a contact closure to ground is required to activate a given function. With the Inverter Assembly installed, interfacing is on a positive-active basis (open contacts activate function). In either case, the system

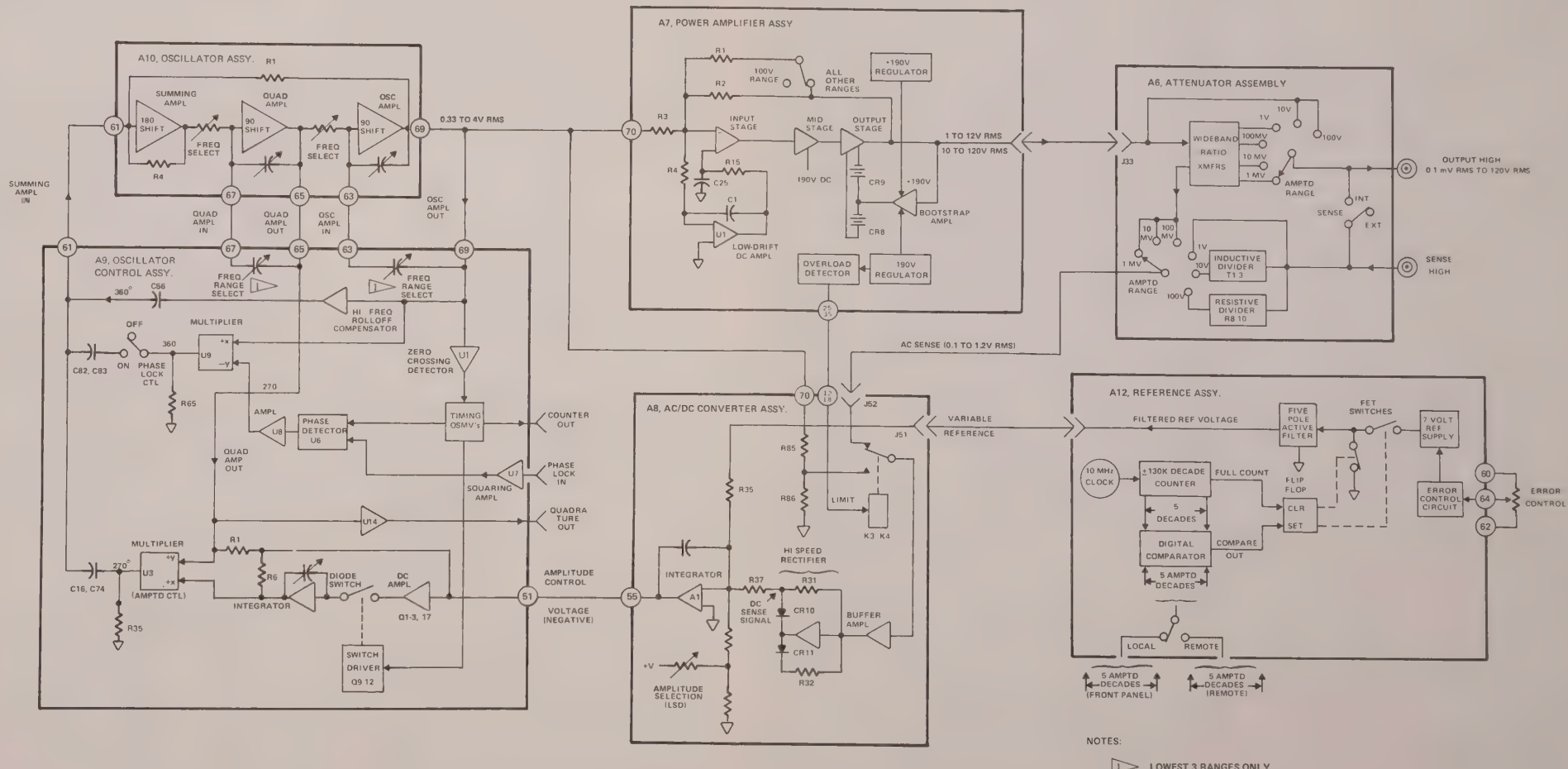


Figure 3-2. 5200A FUNCTIONAL BLOCK DIAGRAM

of logic notation employed throughout the schematics is the standard, positive-true notation. That, the more positive of the two voltage levels (a high) represents the truth of the signal name, the less positive (a low), the falseness of that signal. Also, a bar over an expression represents the word "not" placed before the expression (i.e., $\overline{OP}$ = not operate).

3-41. This system of positive-true logic notation is illustrated on the simplified schematic in Figure 3-3. When the MODE switch (S14) is in the STDBY position, as shown, the input line to inverter U2 will be low. The name of the signal on this line is OP (operate). With the line low, this expression (or signal name) is false. Since the operate condition is false, the OPER indicator should be off, and the STDBY indicator should be lit. An inspection of the schematic will show that this is the case. If switch S14 were set to OPER, the STDBY indicator would to out, and the OPER indicator would light. The OP line would then be high, and the expression OP (operate) would be true. At this same time, the output of U2 is low. Therefore, the expression on that line $\overline{OP}$ (not operate) would be false, implying that the operate condition is true. Note that the signal name to the right of jack J12H could just as well be STANDBY, since "not operate" is the equivalent of "standby."

3-42. Motherboard PCB Assembly, A2

3-43. This assembly interconnects the other pcb's of the 5200A (dwg No. 5200A-1010). It is located across the front of the unit, just behind the Switch pcb assembly, A3 (see Figure 5-1). The Motherboard assembly consists of 8 female, 86-pin, card-edge connectors and 83 individual male connector pins all mounted on a pcb. The 8-card-edge connectors mate with pcb's A5 through A12; the 83 connector pins mate with corresponding receptacles on pcb A3. The 83 individual pins are divided into 8 groups. lettered A through F, H, and K. Each pin is uniquely designated, starting at the top of each group with P1, suffixed with the group letter, and proceeding consecutively to the bottom. For example, the fifth pin from the top in group H is pin P5H (mates with jack J5H on pcb A3).

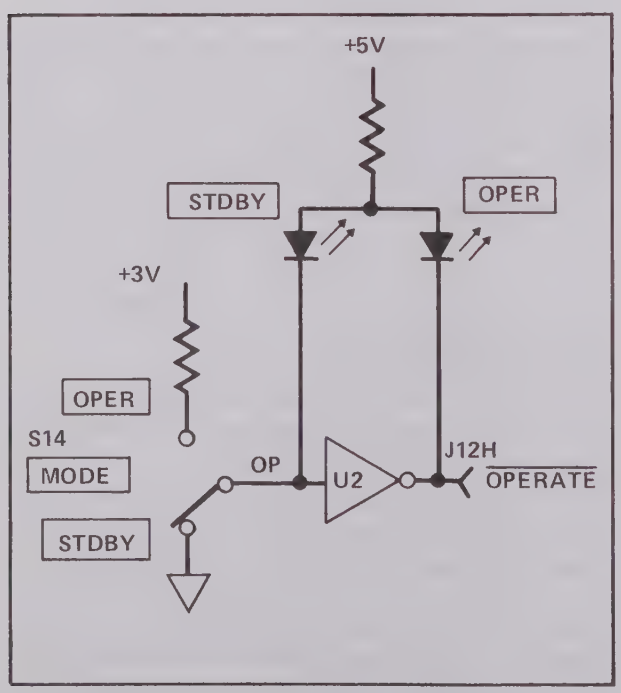


Figure 3-3. LOGIC SIGNAL NOTATION

3-44. Switch PCB Assembly, A3

3-45. The Switch pcb assembly, A3, is located between the front panel and the Motherboard assembly. (See Figure 5-1). This pcb contains the switch decks and the light-emitting diodes (LED's) for the front panel switches and indicators, respectively. It also contains logic elements associated with these switches and LEDs.

3-46. (Refer to schematic diagram 5200A-1011.) When dc power comes on, the ON indicator by the POWER switch will light. Until sufficiently charged, capacitor C1 will place a low on pin 13 of U2, initially placing the Mode flip-flop in the Standby state ($\overline{OP1}$, or "not operate 1" will go high, or true). (Throughout the schematics, the numeral 1 following an OP, an EXT SEN, or a PHASE LOCK signal, denotes the signal as originating in the 5200A, while the numeral 2 denotes an external origin.) Should an overload occur, $\overline{LIMIT}$ will go low at jack J12, lighting the OVERLOAD indicator. CR43 and CR48 are connected as a wired OR circuit to form the Interrupt Operate (INT OP) function. This circuit acts to place the instrument into the STANDBY condition at power-off and during frequency range switching. U5 on the Power Supply Mother PCB acts as a 30 second turn on delay. The switch PCB input on J19H will be high for approximately 30 seconds after power is applied. This signal is inverted by U3 and connected to the Interrupt Operate Line by CR48. U10 and CR43 will activate the Interrupt Operate line during frequency range switching. U8 stores the range setting. U7 detects changes and triggers U10. U8 is then reset by a pulse from U11. Q18 on the Power Supply Mother PCB acts as a power-off detector. The signal from Q18 is connected to the Interrupt Operate line on the Mother PCB.

3-47. The CONTROL switch, S15, selects either local or remote control for the 5200A. When S15 is set to REM, pin 6 of gate U2 goes high, disabling the MODE, the PHASE

LOCK, and the SENSE switches. This high also turns off transistor Q1, disabling the FREQUENCY decade switches and the VOLTAGE (least significant digit) decade switch. (The rest of the VOLTAGE decade switches are disabled by using the low from switch S15 through jack J10C to inhibit their signals at the RCU Gating circuits on the Reference Supply Assembly, A12.) The high out of U2-6 is also applied to input D of bcd-to-decimal converters U4 and U5. This causes outputs 0 through 7 to be held high, allowing no decimal point LED to light. The high out of U2-6 is inverted to a low at pins 8, 4, and 10 of three U3 inverters. The low out of pin 8 inhibits the three U1 and the three U6 gates, thus disabling the FREQUENCY RANGE –Hz and the VOLTAGE RANGE switches, respectively. The low out of pin 4 of U3 turns off transistor Q2, de-energizing relay K1, and thus disabling the VOLTAGE ERROR - % switch. The low out of pin 10 of U3 turns on the REM indicator and holds the Mode flip-flop in the Standby state. All of the foregoing conditions will be true regardless of the position of the CONTROL switch if an external programming source has activated the Remote function. The CONTROL switch would be overridden by a low at jack J1C ($\overline{\text{RCU REMOTE}}$, or " not RCU remote", would be false).

3-48. When the 5200A is in the Remote mode of control (whether locally or remotely selected), and there are no (other) external commands, the STDBY and the INT indicators will be lit, and the ON indicator by the PHASE LOCK switch will be out. Externally programmed commands may alter any of these three conditions. An external contact closure to ground may be applied, by way of the Remote Control Unit pcb, A11, to jack J3C. This would have the same effect on the 5200A as setting the PHASE LOCK switch to ON when the CONTROL switch is set to LOCAL; the phase lock ON indicator would light, and the phase lock feature would be activated ($\overline{\text{PHASE LOCK}}$, at jack J1E, would be false). Similarly, a ground applied by way of A11 to pin 54 of connector P30 (edge connector of pcb A6) would cause jack J11H to go high, having the same effect as setting the SENSE switch to INT while in the Local mode of control; the INT indicator would go out and the EXT indicator would light. Again similarly, a ground applied by way of A11 to pin 30 of connector P30 would cause jack J17H to go low, having the same effect as momentarily setting the MODE switch to OPER while in the Local mode of control; the STDBY indicator would go out, the OPER indicator would light, and the 5200A would be placed into the Operate mode. Note that the Mode flip-flop would be unaffected, remaining locked in the Standby state by the low state of pin U3-10. The output of this flip-flop is by-passed by the external Operate command, which is applied to the 5200A downstream of the flip-flop.

3-49. When the CONTROL switch is set to LOCAL, and jack J1C is high ($\overline{\text{RCU REMOTE}}$, or "not RCU remote", is true), pin 6 of gate U2 goes low. This low enables the MODE, the PHASE LOCK, and the SENSE switches. It also turns on transistor Q1, enabling the FREQUENCY decade switches and the least significant digit of the VOLTAGE decade switches. (The rest of the VOLTAGE decade switches are enabled by using the high from switch S15 through jack J10C to enable their signals at the RCU gating circuits on pcb A12). The low out of U2-6 applied to input D of U4 and of U5 enables them to output a unique low at outputs 0 through 7 in response to the inputs at A through C, lighting the proper decimal point for the selected range. The three U6 and three U1 gates that feed the A through C inputs of U4 and of U5, respectively, will be enabled by the high out of pin 8 of U3. The high out of pin 4 of U3 will turn on transistor Q2, which will energize relay K1 to enable the VOLTAGE ERROR - % switch, S8. The high out of pin 10 of U3 will unlock the Mode flip-flop, allowing it to respond to the MODE switch.

3-50. Signals from the VOLTAGE RANGE switch are routed to the Attenuator Assembly, A6, by way of Jacks J16H, J14H, and J15H. External voltage range signals exit by the same jacks, after entering A3 by way of J9C, J7C, and J8C, respectively. Signals from the FREQUENCY RANGE - Hz switch are also routed to A6, by way of jacks J9H, J8H, and J13H, and to the Oscillator Control Assembly, A9, by way of jacks J4E, J3E, and J2E. External frequency range signals exit the same jacks, after entering A3 by way of jacks J5C, J4C, and J6C, respectively. (The group M jacks are not used.) Amplitude control signals from VOLTAGE decade switches S1 through S5 are routed by way of group B jacks to the Reference Assembly A12; those from S6, by way of group F jacks to the AC-DC Converter Assembly, A9. Frequency control signals are routed by way of group C and Group D jacks to the Oscillator Assembly, A10. (The group L and group M jacks are not used.)

3-51. Power Supply Assembly, A5 (A5A1, A5A2, and A5A3)

3-52. The Power Supply Assembly supplies all of the dc operating voltages for the rest of the 5200A. It consists of a Power Supply Motherboard assembly; A5, a Power Supply assembly; A5A1, a Power Supply Regulator assembly; A5A2, and a Power Supply Transformer assembly; A5A3. The Power Supply Motherboard assembly, A5, mates with J20 on the 5200A Motherboard assembly; A2. The other three power supply assemblies mate with connectors on A5. All four of the foregoing assemblies are shown on a single schematic diagram: (5200A-1020). The Power Supply Assembly is divided into four functional supplies, each having

special properties. Of all the four supplies, one is outside the guard, the other three, inside. Of the three inside the guard, one is floated (referenced to the SENSE LO terminal), one is referenced to the OUTPUT LO terminal, and the third provides two levels of high voltage for the Power Amplifier circuits.

3-53. The outside supply is so designated because it is the only one of the four that is outside the guard and is used to supply circuits that are also outside. It is located on pcb A5A1 (lower left corner of schematic). The output voltages from this supply are identified by "(O)" following the voltage; such as +5V (O). The letter "O" is also used to distinguish the circuit return symbol for this supply from that of the other supplies.

3-54. The output voltages and circuit return symbol for the floated supply (upper right corner of schematic) are similarly identified with the letter "F". This supply is referenced to the SENSE LO terminal and is used primarily in circuits having to do with amplitude control (AC-DC Converter and Reference Supply). The floated supply occupies part of pcb A5A2.

3-55. The other part of pcb A5A2 holds the supply (lower right corner of schematic), that is referenced to the OUTPUT LO terminal. The voltages for this supply are identified by the absence of any special marking, but the circuit return symbol is identified by the letter "L". This supply provides the voltages for the bulk of the circuits inside the guard.

3-56. The last of the four supplies (right center of schematic) is located directly on pcb A5, and provides the operating voltages for the output stage of the Power Amplifier, A7. The +190V RAW and −190V RAW voltages are actually approximately +240V and −240V, respectively. They are identified as 190V merely because they are the raw voltages that are regulated to 190V on the Power Amplifier pcb.

3-57. Attenuator Assembly, A6

3-58. The Attenuator assembly has two main functions; to attenuate the output of the Power Amplifier assembly (A7) on the 1V and the 1-, 10- and 100-mV ranges, and to provide a proper level of AC Sense signal back to the AC-DC Converter assembly (A8). Both the output and the AC Sense signals are routed within the assembly by means of relays. The relays are controlled by logic circuits that detect the various combinations of selected voltage and frequency ranges, and Sense and Mode commands. Table 3-1 lists the relay paths for both types of signals during Operate mode for each combination of voltage and frequency range. For internal sensing, relay K3 on Switch PCB Assembly is included in the sense path for the 100V, 10V and 1V ranges.

3-59. The attenuation of the output signal is accomplished by one of three precision, ratio transformers; T1, T2 or T3, depending on the selected frequency range. (See schematic diagram 5200A-1030, sheet 1). When either the 100V or the 10V range is selected, the output signal is applied directly to the front and the rear attenuator output connectors by relay K1 (no attenuation takes place). However, when the 1V range or any of the three mV ranges are selected, relay K1 is open, and relay K34 applies the output signal to one of the three transformers by way of relay K4, K5 or K6. The selected frequency range determines which of the three relays is closed (in addition to K34), and therefore, which of the three transformers is used. (On the schematic diagram, all relay contacts are marked with the conditions required to close them. For all other conditions, the contacts are open).

3-60. In order to provide the AC-DC Converter with the same level of AC Sense signal (0.1 to 1.2V rms) no matter what the selected voltage range, the Sense signal is attenuated on the 100V and the 10V ranges, fed straight through on the 1V range, and taken directly from the secondary of the applicable transformer on all three mV ranges. The attenuation on the 100V range is accomplished by a resistor voltage divider consisting of resistors R8, R9 and R10. Resistor R9 is a potentiometer used for calibration purposes. Capacitor C3 is variable to provide calibration of the divider on the 1-MHz frequency range. On the 10V range, the Sense signal is attenuated by the primary of the applicable transformer. The transformers are not being used for output signal attenuation on the 10V range, so the primaries are used as inductive voltage dividers. The Sense signal is applied to the primary by section A of relay K10, K12 or K14, as applicable, and the attenuated Sense signal is picked off by section B of the relay.

3-61. The foregoing is true only for the Operate mode. When the MODE switch is set to STDBY, relays K1 and K15 through K26 cannot be energized. (Refer to sheet 2 of 5200A-1030.) Whenever input D of decoder U10 is high, as it is during Standby mode, outputs 0 through 7 are held high. Logic signals F through N (outputs 0 through 7 inverted) are held low, inhibiting the drive gates for K1 and K15-26. Whichever of these relays are closed during Operate mode, will open when the unit is placed into Standby mode, thereby removing the output voltage from the OUTPUT HI terminal(and the corresponding pin of the rear output connector).

3-62. Also during the Standby mode, a substitute AC Sense signal to the AC DC Converter is provided to maintain balance in the amplitude control loop. With the output voltage removed from the output line, there can be no voltage on the sense line, and the AC Sense signal must come

Table 3-1. ATTENUATOR PCB, SIGNAL PATH SUMMARY

RANGE	SIG TYPE	100 Hz & 1 kHz	10 kHz & 100 kHz	1 MHz
1000V*	O	K34 → K3A		
	S	K3B → K32		
100V	O	K1		
	S	(R9 →) K27		
10V	O	K1		
	S	K8 → K10 → K32	K8 → K12 → K32	K8 → K14 → K32
1V	O	K34 → K4 → K15 → K2	K34 → K5 → K19 → K2	K34 → K6 → K23 → K2
	S	K8 → K7 → K32		
100 mV	O	K34 → K4 → K16 → K2	K34 → K5 → K20 → K2	K34 → K6 → K24 → K2
10 mV		K34 → K4 → K17 → K2	K34 → K5 → K21 → K2	K34 → K6 → K25 → K2
1 mV		K34 → K4 → K18 → K2	K34 → K5 → K22 → K2	K34 → K6 → K26 → K2
mV (all)	S†	K9 → K32	K11 → K32	K13 → K32

* *Used only in conjunction with Model 5205A Power Amplifier.*

† *Internal sensing only, on all mV ranges, from secondary of xfmrs.*

by another route. (Refer to sheet 1 of 5200A-1030.) In Standby mode, relays K32 and K34 close regardless of the position of the VOLTAGE RANGE switch. Also, depending on the position of the FREQUENCY RANGE-Hz switch one of the following pairs of relays closes: K4, K9; K5,K11 or K6, K13. This established a path for the output of the Power Amplifier to be attenuated by factor of 10 (step-down ratio of transformers, primary to full secondary) and fed to the AC-DC Converter as the AC Sense signal. The output of the Power Amplfifier in Standby mode is the same as it would be in Operate mode for any range other than 100V. The output range of the Power Amplifier is controlled by a signal from pin 2 of U10 (sheet 2). Pin 2 of U10 is held high in Standby mode, regardless of the voltage range selected. Further, in Standby mode, pin 2 of NAND gate U17 goes low, inhibiting the selection of external sensing. The INT indicator will light, and the EXT indicator will be out, regardless of the position of the SENSE switch.

3-63. When a Model 5205A Precision Power Amplifier is used in conjunction with the 5200A, its operation is controlled through the 5200A. When the 1000Vrange is selected, and the 5200A is placed into the Operate mode, pins 8, 10 and 12 of U11 are all high. This causes pin 2 of U9 to go low, activating the 5205A.

3-64. Power Amplifier Assembly, A7

3-65. The function of the Power Amplifier assembly is to amplify the output of the Oscillator assembly to a voltage level adequate to feed the OUTPUT terminals on either the 100V or the 10V range. (The voltage level obtained for the 10V range is also obtained on the four lowest ranges, but attenuated to the desired range by assembly A6.) The gain of the Power Amplifier is fixed at 3 for all ranges except the 100V range. For the 100V range, the gain is fixed at 30 (Operate mode only; the gain reverts to 3 in Standby mode.) Gain switching is accomplished by relays K1 and K2, (see schematic diagram 5200A-1040) The relays are controlled by a signal from the logic circuits of the Attenuator assembly, applied to pin 29 of card connector P40. When the signal is low, K1 opens, and K2 closes. This alters the overall and the input-stage feedback resistances, respectively, and fixes the gain of the Power Amplifier at 30. The only time the signal or pin 29 is low is when both the 100V range and the Operate mode are selected.

3-66. The input stage of the Power Amplifier consists of transistors Q1 through Q9 and their related components. The input stage is a differential, voltage-to-current amplifier. The positive (reference) input to this amplifier is the output of a low-drift dc amplifier (U1). Amplifier U1 monitors the feedback to the input stage from the output stage. Any error in the dc level of the output signal fed back to the signal input (negative side) of the input stage, is detected by U1, which compensates by altering the dc level of the reference input (positive side). This control loop locks the output of the Power Amplifier to a dc level of 0 volts, preventing drift during operation. During calibration, this output dc level is set to zero, as required, by adjusting potentiometer R6.

3-67. The mid-stage amplifier consists of transistors Q34 through Q37 and Q15, and their related components. The mid-stage is a current-to-voltage amplifier. Transistors Q34 through Q37 provide current gain, while Q15, in a common-base configuration, provides high voltage gain.

3-68. The output stage of the Power Amplifier consists of transistors Q14, Q17, Q18 and Q20 through Q23 and their related components. This stage is a complementary emitter-follower bootstrap amplifier. Transistors Q21 and Q22, in Darlington configurations with Q17 and Q18, respectively, provide on-off control for power transistors Q20 and Q23, respectively. Transistors Q17 and Q18 are driven by Q15 of the mid-stage amplifier. Transistor Q14, together with current source diode CR17, provides the potential differential for the bases of Q17 and Q18 that is necessary for smooth transition of the output waveform at the zero-crossing point. The bootstrap effect is provided by zener diodes CR8 and CR9. These two diodes maintain a potential difference of 20V (nominal) between the bases of the power transistors (Q20, Q23) while those bases are swinging through approximately 340V ac, peak-to-peak.

3-69. Transistor Q23, shown on the schematic as a single transistor, is actually a multiple transistor assembly. The transistors are a matched set, making the assembly non-repairable. Hence, it is treated as a single, replaceable transistor.

3-70. Operating power for the output stage is provided by two voltage regulators supplied with raw voltage from assembly A5. The +190V regulator consists of series-pass transistors Q25 and Q26, control transistor Q28, and sensing divider R48/R49. The −190V regulator consists of series-pass transistors Q31 and Q32, differential control transistors Q29 and Q30, and sensing divider R55/R53. The expression, "+190V RAW" literally means, "the raw input voltage for the +190V regulator"; the dc value of that raw input voltage is actually approximately +240V. Similarly, "−190V RAW" is approximately −240V dc.

3-71. Overload detection begins with transistors Q24 and Q19. As current drawn from the −190V regulator, through resistor R61, increases, the current through Q19 increases, decreasing current through Q24. This makes the collector of Q24 (−190V LIMIT) increasingly positive. When −190V LIMIT becomes positive enough , with respect to −190V REGULATED, transistors Q11 will be turned on. This will turn on Q12, which will turn on Q13. Transistor Q13 will apply a low to pins 12 and 13 of NAND gate U12, and pins 35 and 25 of connector P40 will go high and low, respectively. These two signals are used by assembly A8 to place the 5200A into the Limit mode of operation. Also, the low at pin 25 is used to light the OVERLOAD indicator.

3-72. AC-DC Converter Assembly, A8

3-73. The function of the AC-DC Converter assembly is to rectify the AC Sense signal, compare it to the Variable Reference signal, and develop an Amplitude Control signal (error voltage) directly related to the comparison. The comparison takes place in a summing junction, at the input to a dc operational amplifier (see schematic diagram 5200A-1050, sheet 1). The summing junction is fed on one side by the Variable Reference signal from the Reference assembly (A12) and on the other side by the parallel outputs of a buffer amplifier and a rectifier amplifier. These latter two outputs are derived from the AC Sense signal from the Attenuator assembly (A6).

3-74. The output of the buffer amplifier is a sine wave, equal in amplitude, but 180 degrees out of phase to the input signal (see Figure 3-4, A and B). The buffer amplifier output is fed to the summing junction through resistor R36, and to the rectifier amplifier. The output of the rectifier amplifier is also a sine-wave of equal amplitude, shifted another 180 degrees. Only the negative half-cycles of this output (C) are fed to the summing junction, through diode CR10 and resistor R37. The net result of these two signals being mixed in the summing junction is a full-wave-rectified, pulsating dc voltage (D). When the AC Sense signal and the variable Reference signal are in the proper balance, that is, when all of the current supplied to the summing junction by the positive Variable Reference voltage is drawn by the outputs of the two amplifier, the summing junction potential will be at virtual circuit-common potential, (the pulsating dc voltage will be centered around zero volts) and no error voltage will be developed at the converter output (pin 55 of P50). When more current is drawn, or when less

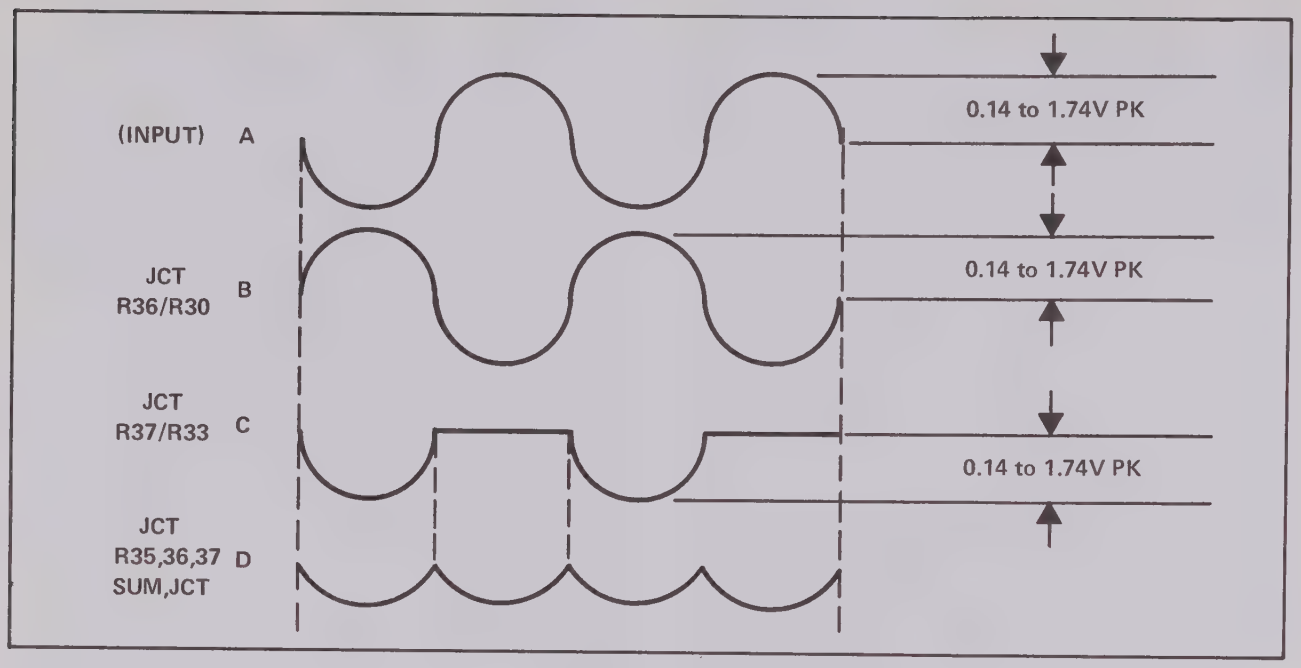


Figure 3-4. AC SENSE SIGNAL PROCESSING

current is drawn, through R36 and R37 than is supplied by R35, the difference is supplied or drawn, respectively, through a summing junction voltage divider (four series resistor pairs in parallel: R48/R49, R51/R52, R54/R55 and R57/R58) to circuit common. This alters the dc potential of the summing junction, and an error voltage is produced at pin 55.

3-75. Also affecting the current supplied to the summing junction, is a resistor-switching circuit (lower left quadrant of the schematic) connected to the junction voltage divider. The resistors (R47, R50, R53, and R56) are switched by FET's into any of 10 possible combinations, corresponding to the 10 positions of the rightmost VOLTAGE decade switch (least significant digit). This resistor-switching circuit is connected between the junctions of the voltage divider resistor pairs and +15V (F) dc. With the decade switch set to 0, all four FET's are open, and no current is supplied by the circuit. As the switch is rotated from 1 to 9, current in digitally increasing increments, is supplied. These amounts of current are small but discrete (approximately 7μA on position 1 to approximately 70 μA on position 9), creating small imbalances in the amplitude control loop that can only be cancelled by small, corresponding increases in the output voltage.

3-76. The pulsating dc signal at the summing junction is applied to one side of an operational amplifier (A8A1, pin 1) This amplifier is referenced to circuit common through pin 2 and resistor R60. (Potentiometer R63 and the three associated resistors R59, R61 and R62, provide a means of precise zero-adjusting during calibration.) The amplifier feeds output transistor Q24 (an emitter follower). The pulsating dc at the summing junction appears at the emitter of Q24, but is filtered at the output by resistor R75 and an active filter U2. Feedback for the operational amplifier is provided by capacitor C25 on the 100 Hz range, and by C26 for the other four ranges.

3-77. Should an overload condition be detected, a Limit signal and its complement would be generated on the Power Amplifier assembly (A7) and applied to the AC-DC Converter assembly (pins 18 and 12 of P50 would go high and low, respectively). Relay K4 would open, removing the AC Sense signal from the input of the buffer amplifier. Relay K3 would close, replacing the AC Sense signal with the output the oscillator amplifier (attenuated by divider R85-R86 to the approximate value of the normal AC Sense signal). This is to maintain stability in the amplitude control loop during overload conditions. It should be noted that voltage is not removed from the OUTPUT HI terminal during a Limit (overload) condition, as it is during Standby mode.

3-78. Oscillator Control Assembly, A9

3-79. The Oscillator Control assembly has a number of functions. The primary function of the assembly is to compare the amplitude control voltage to the positive peaks of the quadrature oscillator output and, as required, provide a correcting input current for the summing amplifier. Second-

ary among the functions is the locking of the Oscillator frequency to an externally supplied frequency when the Phase Lock feature is on. (The external frequency must be within 2 percent nominal of the 5200A selected frequency for phase lock to be achieved.) Other functions are: to translate Frequency Range signals for Oscillator range control, to amplify the output of the quadrature amplifier for application to rear panel BNC connector J65, and to provide the Counter output to rear panel BNC connector J66.

3-80. Control of the Oscillator output amplitude starts with detection of the positive slope zero crossings of the oscillator amplifier output by amplifier U1 (sheet 2). The output of U1 is used to trigger the timing one shots U2A and U2B. The Q output of U2A is used, in turn, to trigger one shots U11, U15A and U15B. The duration of each one shot and the frequency ranges for which they are enabled are shown in Table 3-2. (The enabling signals come from IC gate pack U4 on sheet 1.) The $\overline{Q}$ output of the five one shots are connected to the switch driver circuit (Q9 through Q11) through an AND gate consisting of diodes CR16, CR17, CR64, CR65 and CR67. This AND gate is used to perform the OR function for low inputs). The switch driver circuit will be controlled by the longest-duration pulse applied to the gate. While the input is low, the switch driver will "close" the diode switch, consisting of diodes CR9 through CR12. During this time, the output of the dc amplfiier, which is fed by the Amplitude Control voltage from A8, is connected to the input of the integrator. The integrator in turn feeds the +x input of multiplier U3. The +y input is being fed by the output of the Quadrature amplifier from pcb A8. If the positive peaks of the quadrature amplifier and the Amplitude Control voltage are not in balance, U3 will provide a correcting input current to the summing amplifier on pcb A8.

3-81. In order for the integrator to operate properly over the entire bandwidth of the 5200A, external RC feedback paths are switched in and out, depending on the frequency range selected. The switching is performed by FET's Q29-31 and Q4. These FET's are controlled by BCD-to-decimal converter U5 (sheet 1) through drive transistors Q14-16, and Q25.

3-82. The high-frequency roll off compensator (sheet 2) slightly increases overall Oscillator gain at high frequencies to compensate for intrinsic deficiencies in the three amplifier stages of the Oscillator. It acts as an electronically variable resistor in parallel with feedback resistor R1 on the Oscillator pcb.

3-83. Phase locking starts when an external frequency is squared, by amplifier U7 (sheet 3) and applied to phase detector U6. Zero-Crossing pulses from the timing one-shots are also applied to U6. The phase and frequency differences are detected by U6, which applies a correspondingly offset ac signal to be applied to amplifier U8. The output of U8 feeds the −y input of multiplier U9; the +x input is fed by the output of the oscillator amplifier, on pcb A8. The amplified offset signal will upset the balance between the −y and the +x inputs, and U9 will apply a correcting input current to the summing amplifier on pcb A8. This is, of course, provided that the PHASE LOCK switch is set to ON, energizing relay K5. When the phase and the frequency of the Oscillator, represented by the Zero-Crossing pulses, are the same as those of the external frequency, no offset will be introduced to the input of U8, and no correcting input current will be supplied to the summing amplfiier.

3-84. In order for amplifier U8 to operate properly over the entire bandwidth of the 5200A, external RC feedback paths are switched in and out, depending on the frequency range selected. The switching is performed by FET's Q20-23). These FET's are also controlled by BCD-to-decimal converter U5 (sheet 1) through drive transistors Q14-16 and Q25, as are the FET switches for the amplitude control circuit integrator.

3-85. The frequency range of the Oscillator assembly is determined by the selection of feedback capacitors for the quadrature and the oscillator amplifiers. The capacitors for the three lower ranges are located here on the Oscillator Control assembly (sheet 1). The relays that switch the capacitors in and out of the oscillator circuits are controlled by the same circuit that controls the selection of feedback capacitors for amplifier U8 in the phase-lock circuit. Relays K1, K2 and K3, normally open, close for the 100-Hz, 1-kHz and 10-kHz ranges, respectively. Feedback capacitors for the two higher frequency ranges are located on the Oscillator pcb.

3-86. Rear panel BNC connector J65 (QUADRATURE OUT) is fed by amplifier U14 (sheet 1). Amplifier U14 is fed by the quadrature amplifier (A10A2) and has a gain of 3. The output of U14 is a sine wave with an amplitude of 1V to 12V rms, depending on the settings of the VOLTAGE decade switches, no matter which voltage range is selected.

NOTE !

The quadrature output has a minimum impedance specification of 3 kΩ. Therefore, Lead length from J65 to external equipment becomes critical at the higher frequencies. At 1 MHz, the distributed capacity along a coaxial lead greater than 1 food in length, could overload the quadrature output.

3-87. Rear panel BNC connector J66 (COUNTER OUT) is fed by pin 6 of gate U13 (sheet 2). This signal is the complement of the longest of the three negative-going pulses applied to U13 from the timing one shot circuit.

3-88. Oscillator Assembly, A10

3-89. The function of the Oscillator assembly is to provide a sine wave, 0.3V to 4.0V rms in amplitude and from 10 Hz to 1.2 MHz in frequency, to the input of the Power Amplifier assembly, A7.

3-90. The Oscillator is the double-integrator type. (Refer to schematic diagram 5200A-1070.) Each of the two integrators (A2 and A3) has five separate capacitive feedback paths (two on this pcb, three on the A9 pcb) that can be switched in and out of the circuit to change the frequency range of the oscillator. The switching is by means of relays, which are operator-controlled by means of the FREQUENCY RANGE-Hz switch. Table 3-2 shows the relay configuration for each selected frequency. For all four relays, section A applies to the quadrature amplifier; section B, to the oscillator amplifier. Relay A10K1 is held closed on all ranges except 1 MHz. The extra capacitance it provides on the three lower ranges offsets the slight isolation of the range-select capacitors on the A9 pcb caused by the distributed inductance of the traces to those capacitors.

Table 3-2. FREQUENCY RANGE RELAYS

	RELAY			
RANGE	A9K1	A9K2	A9K3	A10K1
100 Hz	C	O	O	C
1 kHz	O	C	O	C
10 kHz	O	O	C	C
100 kHz	O	O	O	C
1 MHz	O	O	O	O

C = Closed; O = Open

3-91. The frequency of the Oscillator, within the selected range, is determined by the net value of resistance between amplifier stages. There are 16 separate resistor paths between amplifiers A1 and A2 and an identical circuit between amplifiers A2 and A3. These resistor paths are switched in and out of the Oscillator circuits by FET's Q18 through Q49. The FET's are driven by 16 drive transistors (Q1 through Q17; Q4 not used) in response to the FREQUENCY decade switches. Each drive transistor drives two FET's, one from each interstage resistor circuit. Each group of four drive transistors and their associated FET's translates the position of one of the four FREQUENCY decade switches on an 8-4-2-1, binary code basis.

3-92. Reference Assembly, A12

3-93. The function of the Reference assembly is to provide a Variable Reference voltage, proportional to the settings of the VOLTAGE decade switches, for use by the AC-DC Converter for amplitude control. This Variable Reference voltage is the positive dc output of a five-pole active filter. The input to the filter is alternately switched back and forth from circuit common to +7V dc. The duty cycle of the +7V portion of the filter input is controlled by the selected-amplitude information from the VOLTAGE decade switches (or from the RCU, as applicable).

3-94. The selected-amplitude information is applied to the RCU gating circuits (see schematic diagram 5200A-1090, sheet 2). The signal on pin 53 of P90 determines which set of amplitude information is gated to the comparator. When pin 53 is high, the information from the VOLTAGE switches is gated; when it is low, that from the RCU is gated.

3-95. The other side of the comparator is fed by a counter that is driven by a 10-MHz clock. Every 13 ms, the counter increments from 00000 to 130000. The most significant digit (U16) of the counter is monitored by a NAND gate. When U16 reaches 13 (full count), normally high pin 6 of gate U18 goes low. This low clears U16 and pin 6 reverts to a high. This short-duration low from pin 6 pulses transformer T2.

3-96. The other side of T2 is fed by pin 8 of NAND gate U18. This gate monitors the output of the comparator. As the counter increments, there will be a 0.1-μs period of time (somewhere from 10000 to 119999, inclusive) when the counter output is exactly the same as the selected-amplitude information.. During that period of time the outputs of all the comparator gates will be high, and normally high pin 8 of U18 will go low. This 0.1 -μs low from pin 8 pulses T2 in the opposite direction as pin 6.

3-97. The two opposite-polarity pulses to T2, the first when a compare is reached; the second when full count is reached, are fed to a flip-flop inside the guard (see sheet 1). The flip-flop drived FET's Q9 and Q11, which control the input to the five-pole filter. From a Full Count pulse to the following Compare pulse, Q9 is on, Q11 is off, and +7V dc is applied to the filter. From the Compare pulse to the following Full Count pulse, Q9 is off, Q11 is on, and circuit common [15V (F) Return] is applied to the filter. The resulting output of the filter is a positive dc voltage proportional to the settings of the VOLTAGE decade switches (except for the rightmost switch), or to the remotely supplied amplitude control inputs, as applicable.

Section 4
Maintenance

4-1. INTRODUCTION

4-2. This section contains information on General Maintenance, a Performance Verification test, a Calibration procedure and Troubleshooting information. The calibration procedure should be performed on a periodic basis (90 days) to detect the need for and to make required adjustments. The performance verification test can be used upon receipt of the 5200A and any other time desired to verify the correct operation of the equipment. The troubleshooting procedures will aid in the isolation of a fault to a particular pcb assembly and further, to a circuit or particular section of the pcb.

4-3. SERVICE INFORMATION

4-4. Each instrument that is manufactured by the John Fluke Mfg. Co., Inc. is warranted for a period of one year upon delivery to the original purchaser. The WARRANTY is located at the front of the manual.

4-5. Factory authorized calibration and service for each Fluke product is available at various world-wide locations. A complete list of domestic service centers is located at the front of this manual. Shipping information is given in Section 2. If requested, an estimate will be provided to the customer before any repair work is begun on instruments that are beyond the warranty period.

4-6. GENERAL MAINTENANCE

4-7. Cleaning Instructions

4-8. Periodically (at least every 90 days) clean the 5200A to remove dust, grease and other contaminants using the following procedure:

a. Insure power is removed from the 5200A.

b. Remove the top and bottom covers and the internal top covers from the power supply and instrument compartments.

c. Remove the air filter from the rear of the fan compartment. Clean the filter using either low pressure clean dry air or a water and mild detergent solution.

d. Clean the interior of the 5200A using low-pressure clean dry air or a vacuum cleaner.

e. If required, clean the pcb assemblies by spraying them with anhydrous ethyl alcohol to loosen the dirt and then remove it with low pressure clean dry air. Allow at least six hours for drying time before reapplying power to the 5200A.

f. Clean the front panel and exterior surfaces with anhydrous ethyl alcohol or a soft cloth dampened with a mild solution of detergent and water.

4-9. Fuse Replacement

4-10. Listed below are the correct replacements for the Line Power Fuses. Use only the correct rating as a replacement, dependent upon the supply voltage:

a. Line voltage 100 or 115 volts - MDX 1½ amp

b. Line voltage 200 or 230 volts - MDX ¾ amp

4-11. Line Voltage Selection

4-12. The 5200A can operate from any one of four possible line voltages. Selection between 100, 115, 200, or

230 is performed by a combination of switch settings which may be changed locally if required. The switches may be set to the desired configuration using the procedure given in Section 2 under the heading of Input Power.

CAUTION

Voltages of ±300 volts are present within the instrument (Power Supply, Power Amp and Front Motherboard) for up to two minutes after power is removed from the system. Extreme caution should be exercised any time that the inner covers are removed from the instrument for servicing.

4-13. Lamp Replacement

4-14. The indicators on the 5200A are Light Emitting Diodes (LEDs). If replacement is required, use the following procedure:

a. Insure power is removed from the 5200A.

b. Remove the VERNIER control knob.

c. Remove, if installed, the shorting links on the front output terminals.

d. Remove the top and bottom covers.

e. Remove the five screws under the side decals that secure the front handles and front panel to the mainframe.

f. The front panel is now free to be moved away from the switch panel for access to the LEDS. The front panel may be removed entirely if desired by removing the wires from the pcb that bring the line voltage to the power switch.

g. Remove the LEDs requiring replacement from the extension sockets and replace.

h. After replacement reassemble the 5200A in reverse order.

4-15. Access to the Mainframe PCB Assemblies

4-16. Use the following procedure to gain access to the pcbs: (Location of the individual pcbs within the instrument compartment is illustrated in Figure 4-1.)

a. Insure power is removed from the 5200A.

b. Remove the top outer and inner covers from the instrument.

c. The desired pcb may be removed by grasping the color-coded retainers and gently rocking the pcb while moving it to the rear. Once the pcb is free from the motherboard lift it out of the instrument compartment. Both the pcb and its location in the motherboard are color-coded for ease in removal and replacement. Some pcbs have conhex cable connectors which must be removed prior to lifting the board free from the motherboard.

d. The two top inner covers have labeled adjustment ports to facilitate the calibration procedure. All calibration points but two power supply adjustments can be reached through these ports. For troubleshooting the boards are removed from the motherboard and installed on an optional extender board. (A4)

e. Reverse the procedure to replace the boards.

4-17. Power Supply Motherboard Removal

4-18. To service the Power Supply Motherboard and its unregulated voltage components use the following procedure:

a. Insure power has been disconnected from the 5200A for at least two minutes.

b. Remove the top outer and inner covers from the instrument.

c. Remove the Attenuator pcb from the instrument.

d. Remove the two small power supply pcbs from the power supply motherboard with a gentle rocking motion and movement to the right.

e. Disconnect the Line Power plug from the Power Supply Transformer board located on the top edge of the pcb at the rear of the Power Supply compartment.

f. Remove the three hold down screws that connect the Power Supply Motherboard bulkhead to the bottom inner cover.

g. Carefully move the power supply motherboard bulkhead with the transformer pcb still attached to the rear with a gentle rocking motion. Once free, move the front of the bulkhead toward the right side and forward to remove the bulkhead and pcbs from the power supply compartment.

h. Reverse the procedure to replace the boards.

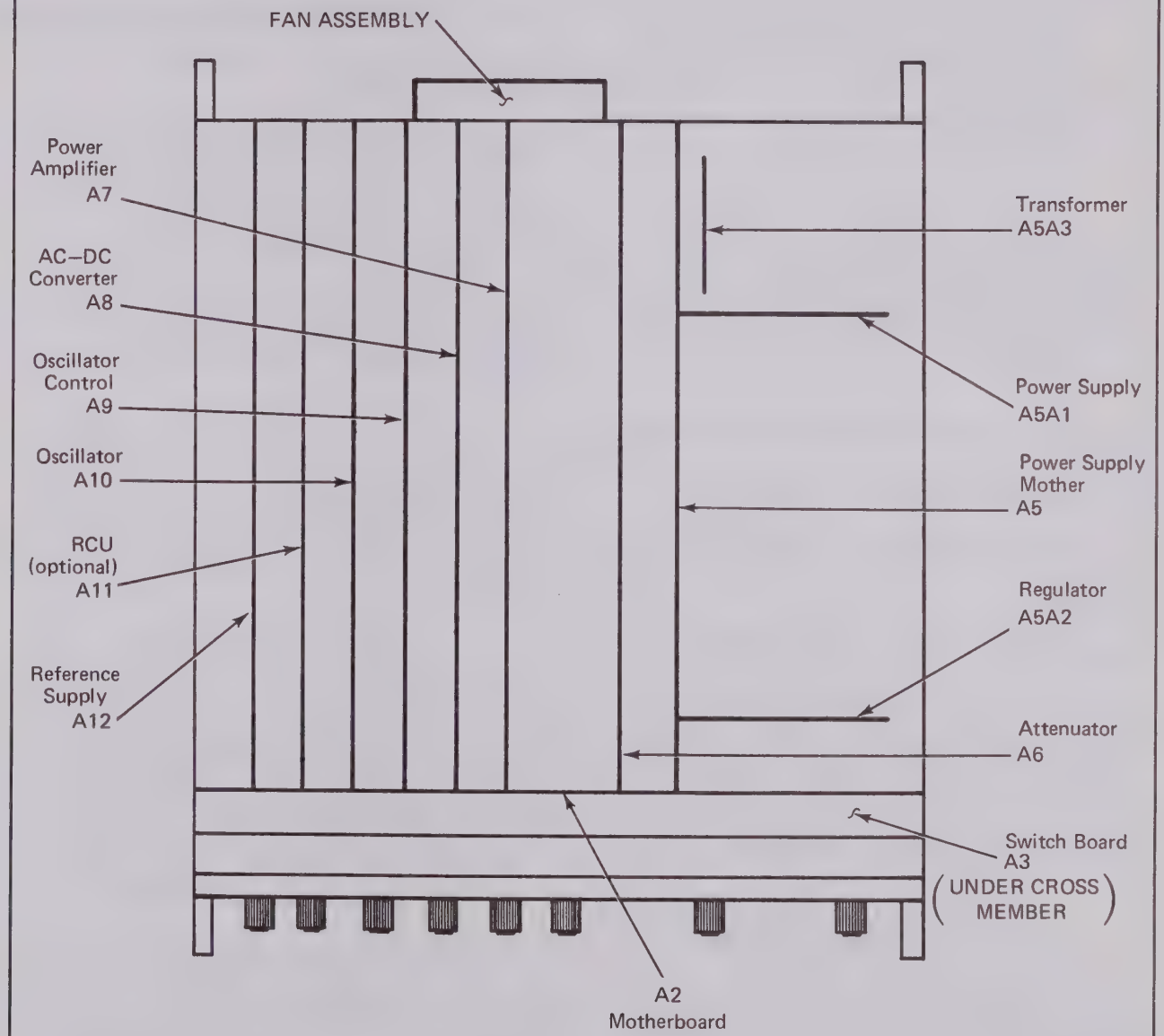


Figure 4-1. PCB ASSEMBLY LOCATIONS

4-19. Front Motherboard Removal

4-20. The front motherboard may be removed using the following procedure after all of the mainframe pcbs and the power supply pcbs have been removed.

a. Set the opened 5200A upright with the Front Panel down.

b. Remove the screws that fasten the motherboard to the mainframe.

c. Carefully lift the motherboard away from the mainframe.

CAUTION

Long pins extend from the motherboard through the mainframe and connect to the Switch pcb assembly. Care must be used to insure that none of these pins are bent or broken while handling this pcb.

d. Reverse the procedure to replace the motherboard.

4-21. Access to the Switch PCB Assembly

4-22. Use the following procedure for access to the switch pcb assembly.

a. Insure power is removed from the 5200A.

b. Remove the VERNIER control knob.

c. Remove, if installed, the shorting links on the front output terminals.

d. Remove the top and bottom covers.

e. Remove the five screws under the side decals that secure the front handles to the front panel.

f. Move the front panel away to gain access to the power switch pcb and disconnect the power wires from it.

g. Remove the hardware holding the four metal covers in place for access to the switches and the switch assembly pcb.

h. Remove the seven screws connecting the pcb to the mainframe and carefully remove the pcb for access to the rear of the switch assembly pcb.

CAUTION

Long pins connect the switch assembly pcb to the motherboard through the mainframe. Care must be used to insure that none of these pins are bent or broken while handling this pcb.

i. Reverse the procedure to replace the switch assembly pcb.

4-23. PERFORMANCE VERIFICATION CHECKS

4-24. Introduction

4-25. The following paragraphs contain a performance verification procedure. These tests may be used as an acceptance test upon original receipt of the equipment, to verify calibration at any time prior to a scheduled calibration cycle or as an aid in troubleshooting.

4-26. The test equipment required for the performance test is listed in Table 4-1. If the recommended equipment is not available replacements with equivelant specifications may be used.

4-27. In addition to the test equipment recommended in Table 4-1, several accessory items are required to calibrate and service the 5200A. With the exception of the extender board, these are common items which may be easily obtained or fabricated locally. These accessory items are listed in Table 4-2.

Table 4-1. TEST EQUIPMENT

TEST EQUIPMENT	RECOMMENDED MODEL
Digital Voltmeter	Fluke Model 8600A
Thermal Transfer Standard	Fluke Model 540B
DC Voltage Calibrator	Fluke Model 343A
RMS Differential Voltmeter	Fluke Model 931B
Differential AC-DC Voltmeter	Fluke Model 887A
Test Oscillator	General Radio Model 1310A or Fluke Model 5200A
Phase Meter	Wiltron Model 351 or 355
Wave Analyzer	Hewlett-Packard Model 310A
Frequency Counters	Fluke Model 1900A
Oscilloscope (with sensitive differential plug-in)	Tektronix Model 7603 (with model 7A22 vertical plug-in)
Autotransformer	Variac

Table 4-2. TEST ACCESSORIES

ACCESSORY	USE
Extender Board	Used to gain access to pcb during troubleshooting. Available from John Fluke Mfg. Co., Inc. Request 5200A-7015K Extender Board Kit.
Coax Extension Cables (2 ea.)	Part of Extender Board Kit or can be fabricated from RG 187A/U, RG 188A/U or equivalent. Make approximately 18 inches long with a conhex male connector on one end and a female connector on the other. Used when pcb are on the extender board.
Coax Test Cables (2 ea.)	Fabricate from RG 58U or coax cable with a similar capacity per foot rating. Each cable should be 12 inches long with a BNC male connector on one end and a GR double banana plug on the other. These cables and a BNC "T" are used for voltage accuracy verification and calibration.
Grounding Leads (2 ea.)	Standard leads with insulated alligator clips at each end. Used for proper grounding during accuracy measurements.
Twisted Pair Cable	Fabricate from twisted pair with foil or similar shielding. The cable should be approximately three feet long. It should have two BNC male connectors on one end with the shield connected to the BNC shell. The other end should have the pair connected to the GR double banana and the shield connected to a GR single banana plug. This cable is used for verification and calibration of the millivolt levels.
Loads	Loads with the following values are required to check load regulation at various levels. Placing each load across a GR double banana plug facilitates their use. 0 ohms (short) — 20 ohms/1 watt — 50 ohms/2 watts 200 ohms/2 watts — 2K ohms/10 watts — 593pF/100 volts
Accessories	Standard adapters, connectors and cables as required.

4-28. Equipment Set-Up

4-29. Perform the following procedure prior to beginning any operation. The equipment should have a warm-up period of at least one hour prior to performing any test.

a. Insure that power is applied to the 5200A and the POWER switch is ON.

b. Set the MODE switch to STDBY.

c. Set the CONTROL switch to LOCAL.

d. Set the PHASE LOCK switch to OFF.

e. Set the SENSE switch to EXT.

f. Set the VOLTAGE ERROR-% switch to OFF.

g. Verify that only those indicators selected by the listed switch settings, plus the decimal indicators applicable for the voltage and frequency ranges selected are illuminated. All other indicators, including OVERLOAD, should be extinguished.

4-30. Output Accuracy Test - Voltage Ranges

4-31. The output accuracy test may be performed by either of two different methods. The first and preferred method uses the thermal transfer method (Fluke Model 540B). The A55 Thermal Converters may also be used with the transfer standard for increased accuracy if available. The second method requires a Certified AC Differential Voltmeter (Fluke Model 931B) to perform the test.

4-32. THERMAL TRANSFER METHOD

4-33. Use the following procedure to perform the output accuracy test by the thermal transfer method. Connect the equipment as shown in Figure 4-2 to perform the test.

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Select the desired output voltage and frequency from the 5200A. Suggested, representative voltage and frequency combinations are given in Table 4-3.

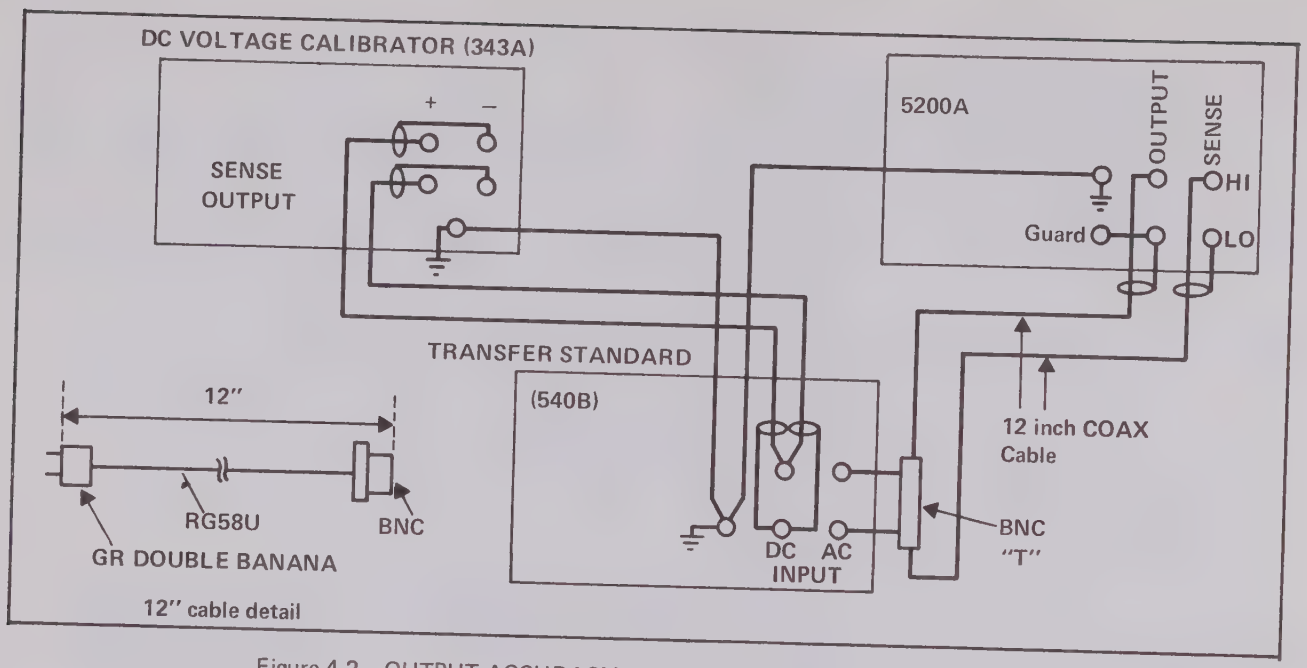


Figure 4-2. OUTPUT ACCURACY TEST EQUIPMENT CONFIGURATION

Table 4-3. OUTPUT VOLTAGE ACCURACY TEST TOLERANCES

FREQ/RANGE	VOLTS/RANGE			
	1/1	1/10	10/10	100/100
1kHz/1kHz	±0.02%	±0.04%*	±0.02%*	±0.02%*
20 kHz/100 kHz	±0.02%	±0.04%	±0.02%	±0.02%
100 kHz/100 kHz	±0.05%	±0.10%	±0.05%	±0.05%
1MHz/1MHz	±0.33%*	±0.66%*	±0.33%	NOT ALLOWED

* These points are adjusted during the calibration procedure.

CAUTION

Ensure that the selected 5200A output voltage and the voltage rating of the thermal transfer standard are the same before continuing.

c. Set the MODE switch to OPER.

d. Perform the transfer measurements. Refer to the transfer standard instruction manual for the procedure for precision ac/dc transfer measurements.

e. Repeat step d for each desired voltage and frequency combination.

4-34. CERTIFIED AC DIFFERENTIAL VOLTMETER METHOD

4-35. This method requires certifying an AC Differential Voltmeter, such as the Fluke Model 931B, at the desired voltage/frequency settings and using it as a Transfer Standard. Care must be taken that the 931B is cycled through certification often enough to verify its stability and repeatability. Use the following procedure to perform the Output Accuracy Test:

a. Connect the equipment as shown in Figure 4-3.

b. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

c. Select the desired output voltage and frequency from the 5200A. Suggested representative voltage and frequency combinations are given in Tabel 4-3.

d. Set the MODE switch to OPER.

e. Perform the measurements using the AC Differential Voltmeter.

f. Repeat step e for each desired voltage and frequency combination.

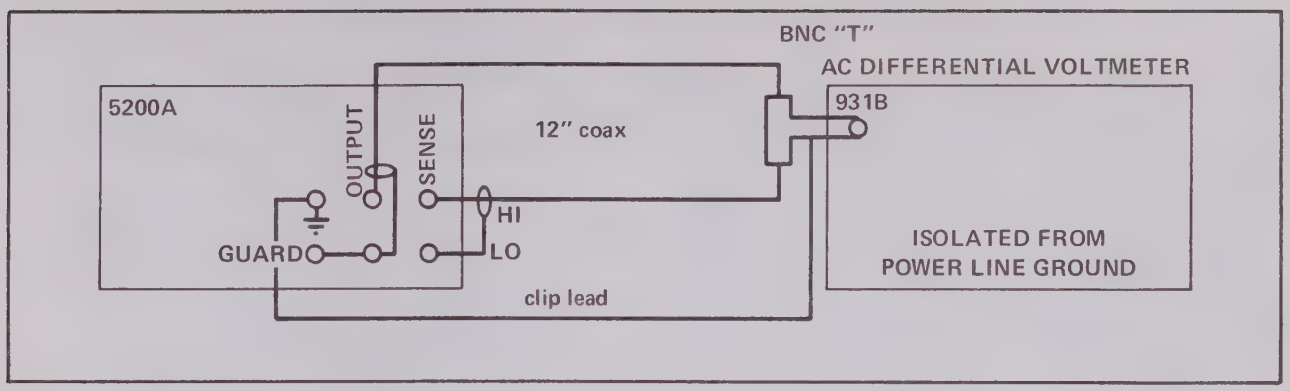


Figure 4-3. OUTPUT ACCURACY ALTERNATE CONFIGURATION

4-36. Output Accuracy Test - Millivolt Ranges

4-37. The 5200A millivolt accuracy depends primarily on the linearity of the control loop and the ratio accuracy of the attenuator transformers. The control loop linearity is calibrated at full scale and one-tenth of full scale in the 10V mode of operation. The source control loop levels are maintained even in the millivolt range of operation, therefore the millivolt output depends primarily on the accuracy of the attenuator transformers and their related circuitry. To test and verify these voltages care is required to insure that ground, guard, shield, thermal, and line related currents are not present, and that external rf radiations do not enter into the measurement signal level.

4-38. The basic method used to verify the millivolt levels is to ratio-down from ten-percent of full-scale on one range to full scale on the next lower range. Voltage accuracy is then the algebraic sum of all errors noted up to that measurement level. The following procedure is recommended for use, and if followed closely, will yield measurements that are substantially correct. It is recommended that the frequencies used be selected according to the normal application of the instrument. If certification with traceability to NBS is required contact one of the John Fluke Technical Service Centers.

4-39. Use the following procedure to perform the millivolt output accuracy test. (Use the specifications listed in Table 4-4 and connect the equipment as shown in Figure 4-3.)

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 100 mV (0.1 volt) on the 1 volt range. Set the frequency range for the desired frequency (typically 1 kHz, 10 kHz, 100 kHz, 1 MHz, etc.).

c. Set the MODE switch to OPER.

d. Vary the ac differential voltmeter (931B) dial settings to obtain a null ±0.01%. Record the meter reading. Do not change the setting of the 931B while the equipment remains in this configuration.

e. Set the 5200A output to 100 mV on the 100 mV range. Remove the 12-inch coaxial cable from the SENSE terminals of the 5200A and ac differential voltmeter.

NOTE!

Internal sensing is automatic on the 5200A millivolt ranges.

f. Algebriacally add the 931B meter reading and the one obtained in step d and record the result. The result should not be greater than the figure listed for the voltage/frequency selected in Table 4-4.

g. Connect the equipment as shown in Figure 4-4 for the remainder of the test.

h. Set the 5200A output to 10 mV on the 100 mV range.

i. Adjust the ac differential voltmeter (931B) and oscilloscope differential amplifier (7A22) gain for a 1 volt rms null. Record the meter reading. Do not change the test equipment settings until the 10 mV readings are complete.

j. Set the 5200A output to 10 mV on the 10 mV range.

k. Record the difference between the null meter reading and the reading obtained in step i. Algebriacally

Table 4-4. MILLIVOLT RANGES OUTPUT ACCURACY TESTS TOLERANCES

	10Hz - 30Hz (0.1% + 10 uV)	30Hz - 20kHz (0.02% + 10 uV)	20kHz-100kHz (0.05% + 20 uV)	0.1MHz-1.0MHz (0.33% + 30uV)
Difference = A 100mV/1V range compared to 100mV/100mV range	±0.11%	±0.03%	±0.07%	±0.36%
Difference + A = B 10mV/100mV range compared to 10mV/10mV range	±0.2%	±0.12%	±0.25%	±0.63%
Difference + B = C 1mV/10mV range compared to 1mV/1mV range	±1.1%	±1.02%	±2.05%	±3.33%

An algebriac total must be calculated to verify the 10mV and 1mV levels. Add the difference noted in the 100mV comparison to the difference noted in the 10mV comparison for a 10mV verification total. Further, add this 10mV verification total to the 1mV comparison difference for a 1mV verification total. If the algebriac totals for each millivolt level is significantly below the specification levels in this table the small error in linearity from full scale to tenth scale may be ignored.

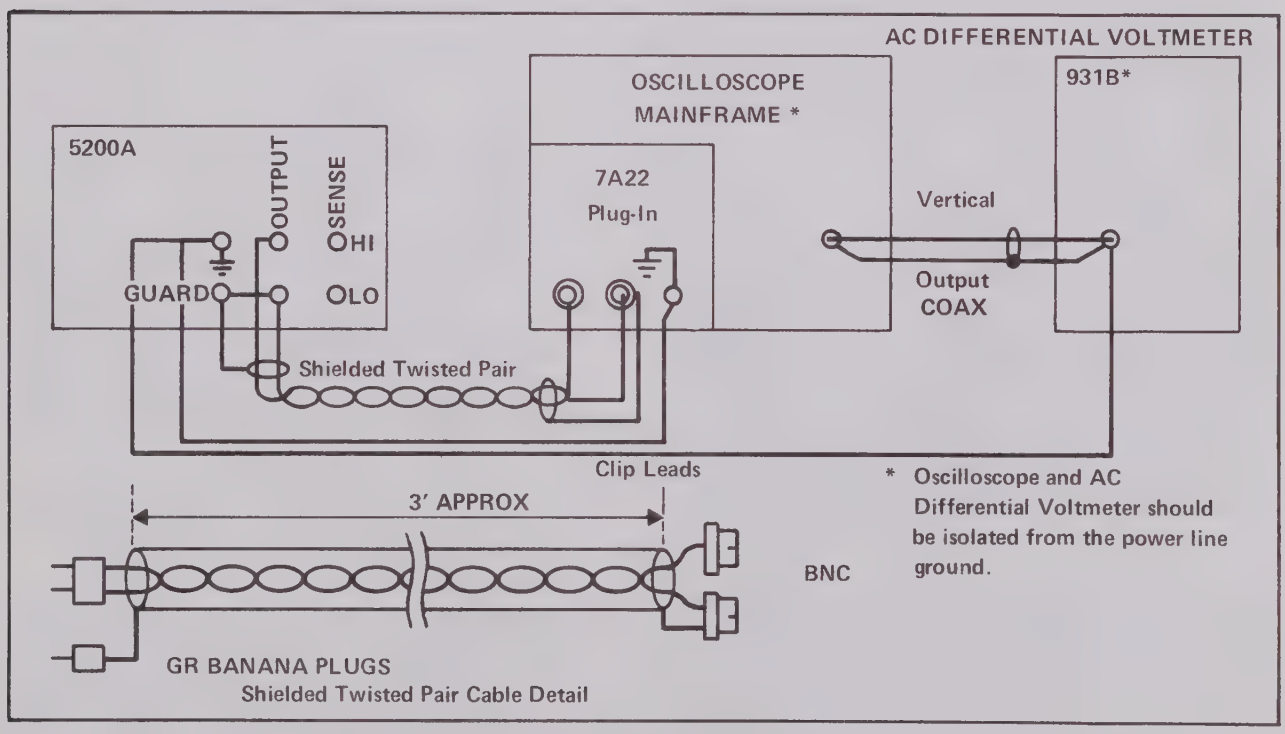


Figure 4-4. OUTPUT ACCRUACY MILLIVOLT CONFIGURATION

add the difference and the reading in step f and record the result. It should not be greater than the figure listed for the voltage/frequency selected in Table 4-4.

l. Set the 5200A output to 1 mV on the 10 mV range.

m. Adjust the ac differential voltmeter (931B) and oscilloscope differential amplifier (7A22) gain for a

1-volt rms null. Record the meter reading. Do not change the test equipment settings until the 1 mV readings are complete.

n. Set the 5200A output to 1 mV on the 1 mV range.

o. Record the difference between the null meter reading and the reading obtained in step m. Algebriacally add the difference and the result in step k and record the result. The result should not be greater than the figure listed for the voltage/frequency selected in Table 4-4.

4-40. Frequency Output Test

4-41. The frequency accuracy of the 5200A may be verified using the following procedure.

a. Connect the frequency counter to the COUNTER OUT connector (J66) at the rear of the 5200A.

b. Set the 5200A to the frequency and voltage desired.

c. Monitor the frequency counter for the selected frequency within the tolerances listed in the specifications in Section 1.

NOTE!

A list of representative frequencies and their tolerances are given in Table 4-5.

4-42. Connect an oscilloscope to the J66 connector at the rear of the 5200A. The output should be at least 2.5 volts peak-to-peak at all frequency ranges.

Table 4-5. FREQUENCY ACCURACY TEST TOLERANCES

FREQUENCY RANGE	SELECTED FREQUENCY	TOLERANCE
100 Hz	50 Hz	±0.6 Hz
	100 Hz	±1.1 Hz
1 kHz	0.5 kHz	±0.006 kHz
	1 kHz	±0.011 kHz
10 kHz	5 kHz	±0.06 kHz
	10 kHz	±0.11 kHz
100 kHz	50 kHz	±0.6 kHz
	100 kHz	±1.1 kHz
1 MHz	0.5 MHz	±0.018 MHz
	1 MHz	±0.033 MHz

4-43. Distortion Tests

4-44. Three separate procedures are required to measure the low level of distortion over the entire frequency spectrum of the 5200A. For the lower frequencies up through approximately 20 kHz a total harmonic distortion analyzer may be used provided it has a low enough noise floor. From 20 kHz through 400 kHz a wave analyzer is required to find and totalize the harmonic levels. A spectrum analyzer is required for the harmonic levels from 400 kHz through the remainder of the frequency range to 1.2 mHz.

4-45. The procedure to verify the 20 kHz to 400 kHz area is described below. To use either of the other methods refer to the instruction manual for the test instrument selected.

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the SENSE switch to INT.

c. Connect the 5200A output to the Wave Analyzer input.

d. Set the 5200A output to the voltage and frequency range desired.

e. Set the MODE switch to OPER.

f. Measure and record the reading on the wave analyzer at the second and third harmonic of the selected frequency.

g. Calculate the root mean square (the square root of the sum of the squares) of the readings obtained above and verify it is within the specifications listed in Section 1 for the frequency and voltage selected.

h. Apply a 50 mA load.

i. Repeat steps f and g above with the load applied.

NOTE!

Table 4-6 contains a list of representative frequencies, voltages, loads and tolerances for the Harmonic Distortion test.

4-46. Overload Test

4-47. The overload indicator illuminates when the output load substantially exceeds the maximum specified 50 mA

Table 4-6. DISTORTION TEST SETTINGS AND TOLERANCES

FREQUENCY	RANGE	VOLTAGE	RANGE	LOAD VALUE	NO LOAD	FULL LOAD
20 kHz	100 kHz	1 volt	1 volt	20 ohms	< 0.041%	< 0.1%
50 kHz	100 kHz	1 volt	1 volt	20 ohms	< 0.041%	< 0.19%
100 kHz	100 kHz	1 volt	1 volt	20 ohms	< 0.041%	< 0.34%
20 kHz	100 kHz	10 volts	10 volts	200 ohms	< 0.041%	< 0.046%
50 kHz	100 kHz	10 volts	10 volts	200 ohms	< 0.041%	< 0.055%
100 kHz	100 kHz	10 volts	10 volts	200 ohms	< 0.041%	< 0.07%
400 kHz	1 MHz	10 volts	10 volts	200 ohms	< 0.303%	< 0.303%

load limit on the 1, 10 and 100-volt ranges. Use the following procedure to perform the overload test:

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10-volt range.

c. Set the 5200A output to 1 kHz on the 1 kHz range.

d. Connect an AC Differential Voltmeter to the 5200A as shown in Figure 4-3.

e. Apply a 200-ohm, 2-watt carbon composition resistor to the output terminals of the 5200A.

f. The output voltage should change less than ±500 uV rms (±0.005%) for the applied 50 mA rms load.

g. Remove the 200-ohm resistor and apply a 50-ohm, 2-watt carbon composition resistor.

h. The overload indicator should light and the measured output voltage should drop.

i. Remove the 50-ohm resistor.

j. The overload indicator should go out and the measured output voltage should return to its original reading.

k. Repeat steps g through j substituting a shorting wire for the 50-ohm resistor. The results should be the same.

4-48. Load Regulation Verification Test

4-49. Perform the load regulation test using the following procedure:

a. Connect the equipment as shown in Figure 4-3.

b. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

c. Set the 5200A output to the voltage and frequency combinations desired for load regulation verification. Representative values are listed in Table 4-7.

d. Set the MODE switch to OPER.

e. Obtain a null on the ac differential voltmeter (931B).

f. Apply the required load to the 5200A OUTPUT terminals.

g. Note the reading on the ac differential voltmeter (931B). After settling it must not have shifted more than allowed in the specifications in Section 1.

4-50. Line Regulation Test

4-51. The 5200A line regulation may be checked using the following procedure:

a. Connect the 5200A to the input line voltage through an autotransformer. Adjust the autotransformer for an input voltage of 115 volts AC.

NOTE

This procedure is written on the assumption that the standard 115 volts has been selected as the input line voltage. If any of the other three possibilities (100, 200 or 230) have been selected the figures listed as the basic ±10% must be adjusted accordingly.

b. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

Table 4-7. LOAD REGULATION TEST VALUES AND TOLERANCES

VOLTAGE	RANGE	FREQUENCY	RANGE	LOAD	TOLERANCE
1 volt	1 volt	20 kHz	100 kHz	20 ohms	±0.006%
1 volt	1 volt	100 kHz	100 kHz	20 ohms	±0.01%
1 volt	1 volt	1 MHz	1 MHz	50 ohms	±0.1%
10 volts	10 volts	20 kHz	100 kHz	200 ohms	±0.006%
10 volts	10 volts	100 kHz	100 kHz	200 ohms	±0.01%
10 volts	10 volts	1 MHz	1 MHz	200 ohms	±0.1%
100 volts	100 volts	20 kHz	100 kHz	2k ohms	±0.006%
100 volts	100 volts	100 kHz	100 kHz	2k ohms	±0.012%
60 volts	100 volts	0.2 MHz	1 MHz	593 pF	±0.04%

c. Set the 5200A output to 10 volts on the 10-volt range and 1 kHz on the 1 kHz range.

d. Connect the equipment as shown in Figure 4-3, replacing the ac differential voltmeter (931B) with a Fluke Model 887A AC-DC Differential Voltmeter.

e. Set the MODE switch to OPER.

f. Adjust the differential voltmeter for an ac null.

g. Lower the line voltage to 103 volts.

h. The output voltage should not change more than ±100 uV.

i. Raise the line voltage to 127 volts.

j. The output voltage should not change more than ±100 uV from the reading at 115 volts.

4-52. Phase Lock

4-53. The 5200A Phase Lock circuitry may be checked using the following procedure:

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Connect the 5200A OUTPUT terminals to one channel of a dual channel oscilloscope.

c. Connect the other channel of the oscilloscope to a test oscillator.

d. Connect the test oscillator output to the 5200A PHASE LOCK input (J64) on the 5200A rear panel.

e. Obtain an output from the test oscillator of 10 volts rms at 1 kHz.

f. Set the 5200A for an output of 10 volts at 1 kHz.

g. Set the oscilloscope to external trigger and the input mode to chop. The two wave forms should be displayed, out of phase with each other.

h. Set the PHASE LOCK switch to ON. The two waveforms should come into sync on the display.

i. Further verification of the phase lock operation may be made by adjusting the 5200A frequency to ±2% of the test oscillator frequency. When the PHASE LOCK switch is turned back ON sync between the two waveforms should be restored. Lock should occur at all 5200A output frequencies as long as the 5200A and test oscillator frequencies are within 2% of each other.

NOTE

If phase lock angles require verification use the phase lock calibration procedures.

4-54. Quadrature Output Test

4-55. The voltage level at the QUADRATURE OUT (J65 on the rear panel) should vary from one to ten volts ±10%, as selected by the most significant digit of the voltage range. The following procedure verifies the amplitude accuracy for the 1 MHz range: (Other frequency ranges should be substantially better in output level flatness versus frequency.)

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10-volt range and 1 MHz on the 1 MHz range.

c. Connect the ac differential voltmeter to the quadrature output using a 12-inch RG58U or equivalent coaxial cable.

d. Set the MODE switch to OPER.

e. Obtain a 10% range null on the differential voltmeter.

f. Vary the frequency through the 1 MHz range. The quadrature output should be 10 volts rms ±10% throughout the entire range.

g. Other frequency ranges, as desired, may be checked in the same manner.

4-56. Voltage Error Control Test

4-57. Use the following procedure to check the voltage error control:

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A for an output of 10 volts on the 10-volt range and 1 kHz on the 1 kHz range.

c. Connect the equipment as shown in Figure 4-3.

d. Set the MODE switch to OPER.

e. Obtain a null on the ac differential voltmeter (931B).

f. Set the VERNIER dial to 0 and the VOLTAGE ERROR-% switch to X1.

g. The ac differential (931B) indication should not change more than ±0.01% (±1 mV).

h. Check the end point accruacy of the vernier by setting the ac differential voltmeter (931B) dials to 10.3XXX (least-significant digits are variable) and the 5200A VERNIER dial to –3.0. The null on the ac differential voltmeter (931B) should be the same as in step g, ±0.05%.

i. Check the other end point accuracy by setting the 931B dials to 9.7XXX and the 5200 VERNIER dial to +3.0. The null on the ac differential voltmeter (931B) should again be the same as in step g, ±0.05%.

j. Repeat steps g through i with the VOLTAGE ERROR-% switch in the X.1 position. The tolerances increase to ±0.001% and ±0.005% for steps g and h, i respectively.

4-58. CALIBRATION PROCEDURES

4-59. Introduction

4-60. The 5200A Calibration procedure should be performed at least every 90 days. Because of circuit interaction it should be performed in the sequence given in the following paragraphs. The recommended test equipment and accessories are listed in Tables 4-1 and 4-2. It is further recommended that all adjustments be made with a small insulated blade screwdriver.

NOTE

Prior to beginning the periodic calibration procedure it is recommended that the Cleaning Instructions contained in paragraph 4-7 be performed.

4-61. Equipment Preparation

4-62. Prepare the equipment for calibration using the following procedure:

a. Remove the top outer cover from the 5200A.

b. Remove the two inner covers to expose the pcbs.

c. Perform the equipment set-up procedure in paragraph 4-28.

CAUTION!

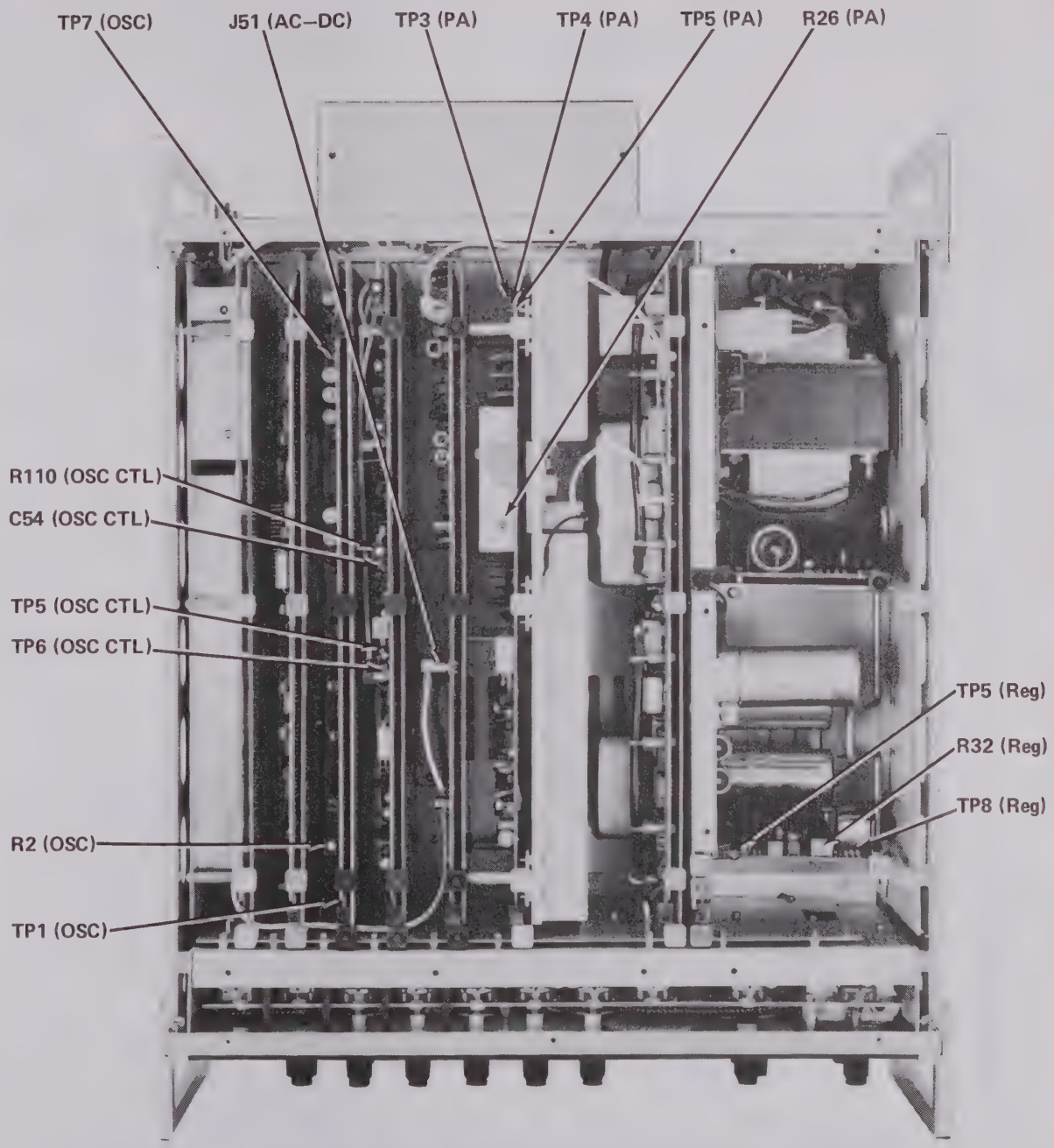
Voltages of ±300 volts are present within the instrument (Power Supply, Power Amp and Front Motherboard) for up to two minutes after power is removed from the system. Extreme caution should be exercised any time that the inner covers are removed from the instrument for servicing.

4-63. Power Supply Calibration

4-64. Use the following procedure to calibrate the Power Supply: (Refer to Figure 4-5 for the test point locations of the Power Supply Regulator and Power Amplifier PCB Assemblies.)

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Connect a DVM to tp8 (HI) and tp5 (LO) on the A5A2 Power Supply Regulator pcb assembly (brown retainer pins).



(Reg)	Power Supply Regulator	(OSC)	Oscillator
(PA)	Power Amplifier	(OSC CTL)	Oscillator Control
(AC-DC)	AC-DC Converter		

Figure 4-5. TEST POINT AND ADJUSTMENT LOCATIONS

c. Adjust R32 on the Power Supply Regulator for a DVM reading of 15 ±0.01Vdc.

d. Prepare the DVM to read +190 volts and move the HI lead to tp3 on the A7 Power Amplifier pcb assembly (yellow retainer pins).

e. The DVM should read at least +185 Vdc. If the reading is less than +185Vdc readjust R32 on the Power Supply Regulator for a minimum reading of +185 volts at tp3. If the error is excessive (20% or greater) the +190V power supply is defective.

4-65. Power Amplifier Bias Calibration

4-66. Use the following procedure to calibrate the Power Amplifier Bias: (Refer to Figure 4-5 for the test point and adjustment locations on A7 Power Amplifier Assembly (yellow retainer pins).)

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Replace the top inner covers. Secure the cover over the power supply compartment only. Allow the 5200A to operate with the covers in place for at least 5 minutes before continuing.

c. Set the MODE switch to OPER and the SENSE switch to INT.

CAUTION!

In the following step tp4 and tp5 are floating at approximately +190 Vdc. Use a floating DVM only. If the DVM has a guard it must be connected to the low input terminal.

d. Remove the inner cover from the instrument compartment and connect the DVM between tp5 (HI) and tp4 (LO) on the Power Amplifier. The DVM should read between 0.34 and 0.36 Vdc.

e. If the reading is not within tolerance turn R26 (Bias Control) fully counter-clockwise for an approximate voltage of 0.2 Vdc. Rotate R26 clockwise until the DVM reads between 0.34 and 0.36 Vdc.

4-67. Special Calibrations

4-68. The calibration procedure in the following six subparagraphs (4-69 thru 4-74) are for circuits that do not normally require calibration. However if the performance test reveals an out of tolerance condition or a component in one of the affected circuits is changed due to a failure they should all be performed in the sequence given at this time. Refer to Figure 4-5 for the test point and adjustment locations on the A9 Oscillator Control pcb Assembly (blue retainer pins) and the A10 Oscillator pcb Assembly (violet retainer pins).

4-69. INTEGRATOR ZERO CALIBRATION

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 1.19 volts on the 1-volt range and to 10Hz on the 100Hz range.

c. Set the MODE switch to OPER and the SENSE switch to INT.

d. Connect the DVM between tp1 (LO) on the oscillator pcb and tp5 (HI) on the oscillator control pcb. Connect a 10K-ohms resistor in series with the HI lead of the DVM.

e. Adjust R110 on the oscillator control board for a reading of 0 ±10 mVdc.

4-70. HIGH FREQUENCY COMPENSATION CALIBRATION

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10 volt range and to 1.1999MHz on the 1MHz range.

c. Set the MODE switch to OPER and the SENSE switch to INT.

d. Connect a DVM between tp1 (LO) on the oscillator pcb and tp6 (HI) on the oscillator control pcb. Connect a 10K-ohm resistor in series with the HI lead of the DVM.

e. Adjust C54 on the oscillator control pcb for a reading of 0 ±200 mVdc.

4-71. FREQUENCY ACCURACY AND QUADRATURE LEVEL CALIBRATION

NOTE

These procedures are combined beacuse of the interaction between the circuits.

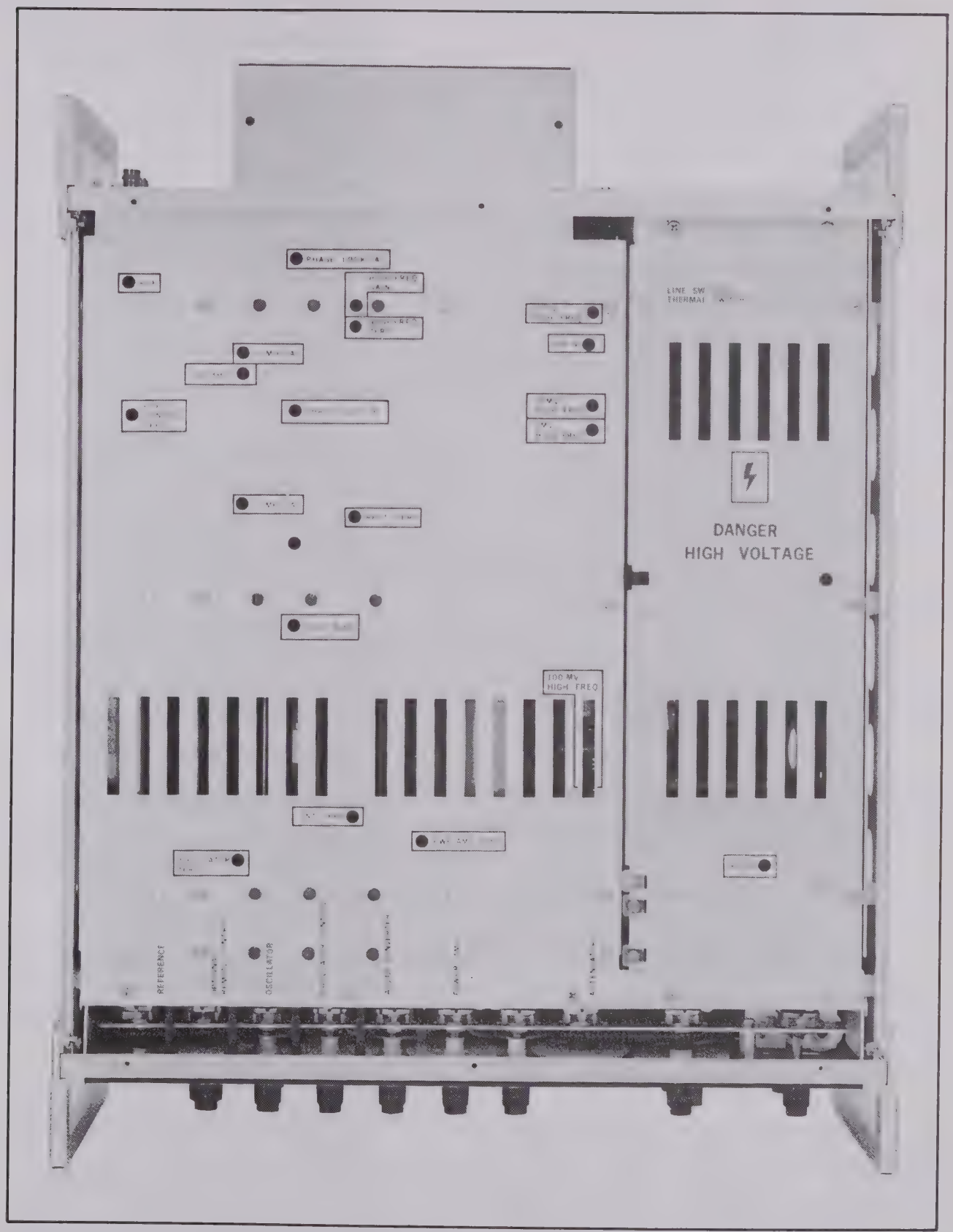


Figure 4-6. LABELED ADJUSTMENT PORTS

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10-volt range and 800kHz on the 1MHz range.

c. Install the instrument compartment inner cover and secure it at one point front and rear.

NOTE

Adjustments may be made through the installed cover at the labeled points, as shown in Figure 4-6.

d. Connect a frequency counter to the 5200A at the COUNTER OUT connector (J66) on the rear panel.

e. Connect an ac differential voltmeter (931B) to the QUADRATURE OUT connector (J65) on the rear panel with a 12-inch RG58U coaxial cable.

f. Set the MODE switch to OPER and the SENSE switch to INT.

g. The frequency counter should read between 792kHz and 808kHz and the quadrature level should be between 9 and 11 volts.

h. If a frequency adjustment is required, adjust 1MHz A2 (C41) and 1MHz A3 (C45) equal amount in the same direction until the frequency is within tolerance.

i. If a quadrature level adjustment is required, adjust 1MHz A2 and 1MHz A3 equal amounts in opposite directions until the level is within tolerance.

j. Set the 5200A output to 80kHz on the 100kHz range.

k. Adjust 100kHz (C42) for a frequency counter reading between 79.6kHz and 80.4kHz.

4-72. PHASE LOCK CALIBRATION

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10-volt range and 1kHz on the 1kHz range.

c. Connect a test oscillator set to 10 volts rms at 1kHz to the PHASE LOCK INP connector (J64) on the 5200A rear panel.

d. Connect two cables of the same length (approximately 2 feet) between the 5200A output and the E1 and E2 inputs of the phase meter as shown in Figure 4-7.

e. Set the MODE switch to OPER and the SENSE switch to INT.

f. Zero the phase meter.

g. Disconnect the 5200A output going to the phase meter E1 input and move it to the PHASE LOCK INP connector (J64).

h. Set the PHASE LOCK switch to ON.

i. Record the phase meter indication.

j. Set the 5200A output to 1 volt on the 10-volt range.

k. The phase meter should indicate the angle obtained in step i $\pm$0.2 degrees. Adjust PHASE LOCK B (R109, Oscillator Control pcb) if required.

l. Repeat steps i through k until the two readings are within 0.2 degrees without making any adjustments.

m. Set the test oscillator output to 1 volt rms.

n. Set the 5200A output to 10 volts on the 10-volt range.

o. Adjust PHASE LOCK A (R52, Oscillator Control pcb) until the phase meter reads 0 $\pm$0.3 degrees.

p. Set the test oscillator output to 10 volts rms.

q. The phase meter reads 0 $\pm$0.3 degrees.

r. Repeats steps o through q until the two readings are within 0.2 degrees without making any adjustments.

4-73. DISTORTION CALIBRATION

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 100-volt range and 100 kHz on the 100 kHz range.

c. Remove the instrument compartment inner cover.

d. Set the MODE switch to OPER and the SENSE switch to INT.

e. Recheck the Power Amplifier bias level. The procedure is detailed in paragraph 4-65.

f. Replace the instrument compartment inner cover.

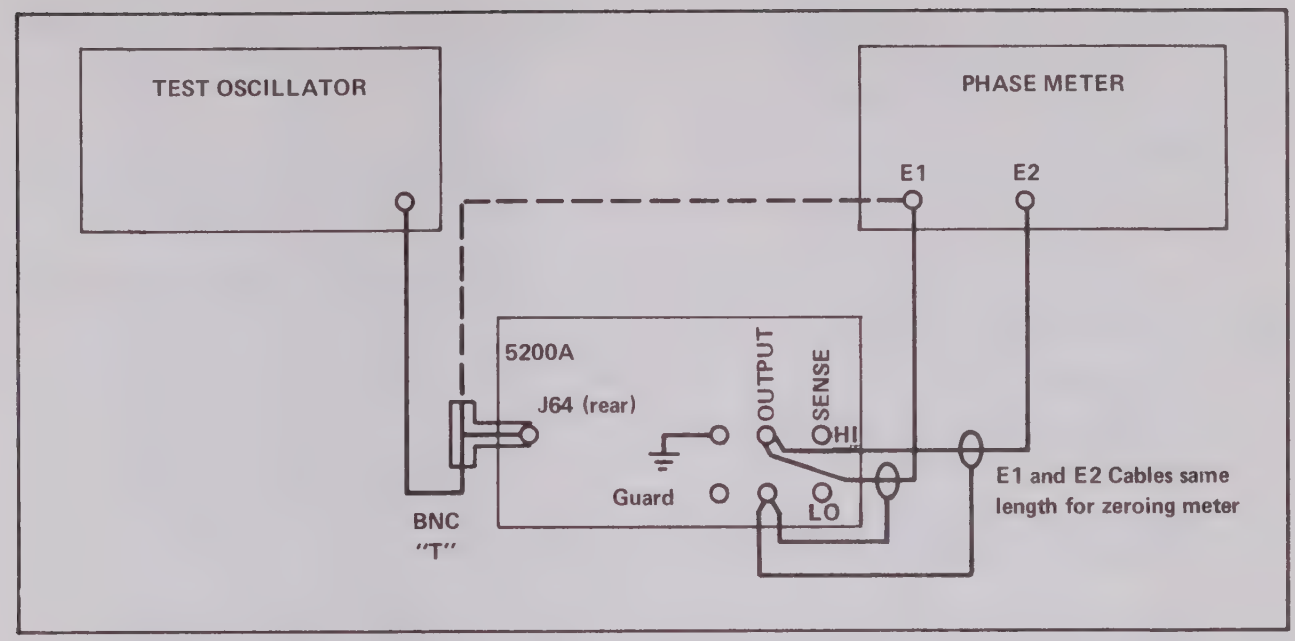


Figure 4-7. PHASE LOCK CALIBRATION CONFIGURATION

g. Connect the wave analyzer to the 5200A output and tune to the second harmonic, approximately 200 kHz, of the input frequency.

h. Adjust OSC DIST (R31, Oscillator Control pcb) for a minimum deflection and record this reading.

i. Tune to the third harmonic and record the meter reading.

j. The root mean square of the readings obtained in steps h and i should be less than 0.041%.

4-74. OSCILLATOR ZERO CALIBRATION

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 1 volt on the 10-volt range and 1kHz on the 10kHz range.

c. Remove the instrument compartment inner cover.

d. Disconnect the white coax cable from J51 on the AC-DC Converter pcb. Connect the shields of the jack and plug together with a short alligator clip lead.

e. Connect a DVM between tp1 (LO) and tp7 (HI) on the oscillator pcb.

f. Set the MODE switch to ON and the SENSE switch to INT.

g. Adjust OSCILLATOR ZERO (R2, Oscillator pcb) for a reading of 0 ±5mVdc.

h. Reconnect the coax to J51 and replace the inner cover.

4-75. Power Amplifier DC Zero Calibration

a. Insure the equipment set-up procedure in paragraph 4-28 has been performed and both inner covers are installed.

b. Connect the equipment as shown in Figure 4-3, replacing the ac differential voltmeter (931B) with a Fluke Model 887A AC-DC Differential Voltmeter.

c. Set the 5200A output to 1 volt on the 10-volt range and 1kHz on the 1kHz range.

d. Set the MODE switch to OPER.

e. Adjust PWR AMP ZERO (R6, Power Amplifier pcb) for 0 ±100uVdc.

4-76. Voltage Amplitude and Linearity Calibration

4-77. The following procedural sub-paragraphs deal with voltage amplitude and linearity for all voltage ranges except the millivolts. The equipment should be connected as shown in Figure 4-2 with both inner covers installed. Adjustments are made through the marked ports in the instrument compartment inner cover as shown in Figure 4-6. Perform the test

in sequence, insuring the equipment set-up procedure in paragraph 4-28 has been performed prior to starting the test.

4-78. LOW FREQUENCY ZERO AND GAIN CALIBRATION

a. Set the transfer standard and dc Calibrator for 1 volt operation.

b. Set the 5200A output to 1 volt on the 10-volt range and 1kHz on the 1kHz range.

c. Set the MODE switch to OPER.

d. Perform the transfer test. The transfer standard null should be 0 ±50 uV (±0.005%).

e. Adjust INT ZERO (R63, AC/DC Converter pcb) until the reading is within tolerance.

f. Set the transfer standard and dc calibrator for 10 volt operation.

g. Set the 5200A output to 10 volts on the 10-volt range.

h. Perform the transfer test. The transfer standard null should be 0 ± 500 uV (±0.005%).

i. Adjust REF (R48, Reference pcb) until the reading is within tolerance.

j. Repeat steps b through i until both readings are within tolerance without and adjustment.

4-79. 100 VOLT LOW FREQUENCY CALIBRATION

a. Set the transfer standard and dc calibrator for 100 volt operation.

b. Set the 5200A output to 100 volts on the 100-volt range.

c. Adjust 100 V (R9, Attenuator pcb) for a transfer standard null of 0 ±5mV (±0.005%).

4-80. HIGH FREQUENCY ZERO CALIBRATION

a. Set the 5200A output to 10 volts on the 10-volt range and 1MHz on the 1MHz range.

b. Set the transfer standard and dc calibrator for 10 volt operation.

c. Measure the error with the transfer standard and record the value.

d. Set the 5200A output to 1 volt on the 10-volt range.

e. Set the transfer standard and dc calibrator for 1 volt operation.

f. Adjust HIGH FREQ ZERO (R89, AC-DC Converter pcb) for the same error as recorded in step c ±0.02%.

g. Repeat steps a through f until they can be performed without adjustment.

4-81. HIGH FREQUENCY GAIN CALIBRATION

a. Set the 5200A output to 1 volt on the 1-volt range.

b. Set the transfer standard and dc calibrator for 1 volt operation.

c. Adjust HIGH FREQ GAIN (R91, AC-DC Converter pcb) for a transfer standard null of 0 ±0.01%.

4-82. HIGH FREQUENCY 100V RANGE CALIBRATION

a. Set the transfer standard and dc calibrator for 10 volt operation.

b. Set the 5200A output to 10 volts on the 100-volt range.

c. Adjust 100V HIGH FREQ (C3, Attenuator pcb) for a transfer standard null of 0 ±0.1%).

4-83. Millivolt Amplitude Calibration

4-84. The millivolt amplitude calibration procedure requires the voltages be checked by a ratio method between ranges. Refer to the Output Accuracy - Millivolt Range performance test, paragraph 4-36 for an explanation of this procedure. The inner covers must be installed and firmly secured for these tests.

a. Connect the equipment as shown in Figure 4-3.

b. Insure the equipment set-up procedure in paragraph 4-28 has been performed.

c. Set the 5200A output to 0.1 volts on the 1-volt range and 1MHz on the 1MHz range.

d. Set the MODE switch to OPER.

e. Adjust the ac differential voltmeter (931B) for a null indication and record the meter reading. Do not

change the settings on the ac differential voltmeter until the 100 mV calibration is complete.

f. Set the 5200A output to 100 millivolts on the 100-millivolt range. Remove the 12-inch coaxial cable from the sense terminals of the 5200A and the ac differential voltmeter

NOTE!

Internal Sensing is automatic on the 5200A millivolt ranges.

g. Adjust 100MV HIGH FREQ (L1, Attenuator pcb) until the ac differential voltmeter (931B) indicates the same value obtained in step e ±0.1%.

h. Connect the equipment as shown in Figure 4-4.

i. Set the 5200A output to 10 mV on the 100-mV range.

j. Adjust the ac differential voltmeter (931B) and oscilloscope differential amplifier (7A22) gain for a 1 volt rms null and record the meter reading. Do not change the test equipment settings until the 10 mV calibration is complete.

k. Set the 5200A output to 10 mV on the 10mV range.

l. Adjust 10MV HIGH FREQ (R12, Attenuator pcb) until the 931B indicates the same null as obtained in step j ±0.3%.

m. Set the 5200A output to 1mV on the 10 mV range.

n. Readjust the ac differential voltmeter (931B) and the oscilloscope differential amplifier (7A22) gain for a 1 volt rms null and record the meter reading. Do not change the test equipment settings until the 1 mV calibration is complete.

o. Set the 5200A output to 1 mV on the 1 mV range.

p. Adjust 1 MV HIGH FREQ (R11, Attenuator pcb) until the ac differential voltmeter (931B) indicates the same null as obtained in step n ±3%.

4-85. Error Control Calibration

4-86. Use the following procedure for the Error Control calibration:

a. Connect the equipment as shown in Figure 4-3, insuring that both inner covers are installed and secured and the equipment set-up procedure in paragraph 4-28 has been performed.

b. Set the 5200A output to 10 volts on the 10-volt range and 1kHz on the 1kHz range.

c. Set the MODE switch to OPER.

d. Obtain null on the ac differential voltmeter (931B) and record the indication.

e. Set the VERNIER dial to 0 and the VOLTAGE ERROR-% to x1.

f. Adjust ERROR CONTROL ZERO (R75 Reference pcb) to the reading obtained in step d ±0.01%.

g. Check the adjustment by rotating the VOLTAGE ERROR-% switch between the X1 and OFF positions. The ac differential voltmeter (931B) reading should not vary as the switch positions change.

4-87. TROUBLESHOOTING

4-88. Troubleshooting Notes

4-89. Troubleshooting for the 5200A consists of a series of text, tabular flow charts and tables. When operating from one tabular flow chart and refered to a second or a table, perform the stated table and then return to the original table and the step being performed when the transfer originated. When a step is completed, if there is no requirement for a decision, follow through and perform the next step in sequence.

4-90. The 30 second time delay is built into the circuit to prevent surges on the output that might damage an instrument connected to the output. This circuit can be disabled while troubleshooting by connecting tp1 to tp2 on the Motherboard Assembly A2.

4-91. Several times the procedure calls for shorting tp4 to tp5 on the AC-DC Convertor Assembly A8. This results in the OVERLOAD indicator illuminating' This is the normal condition for this sequence and is not indicative of a fault.

4-92. Refer to the General Maintenance instructions in paragraph 4-6 when the test procedure indicates a lamp replacement (para. 4-13) or access to the switch pcb assembly (para. 4-21). Access to the switch pcb components, other than the indicator LED, requires removal of the pcb shields and should be done only after it has been verified that all in-

puts to the applicable circuit are present and correct.

4-93. Troubleshooting Sequence

4-94. Start with the Performance Verification check, outlined in Table 4-8 to verify operation of the mainframe, Refer to the test of the indicated assembly or assemblies if troubles arise during the performance tests.

WARNING!

Lethal voltages up to 750V are present on the Power Supply, Power Amplifier, Attenuator, Motherboard and Extender assemblies when in the instrument. In addition, the voltages may be present for up to 3 minutes after power is removed. Extreme caution should be exercised when working with these assemblies.

4-95. Motherboard Assembly A2

4-96. The Motherboard Assembly has no active components. It consists of land patterns and connectors. Check it for continuity with an ohmmeter, removing it from the main frame if required. Group pins B and C are shown out of sequence on the schematic for clarity, however, they are in sequence on the Motherboard, i. e., number one at the top and working down.

Table 4–8. MAIN PROGRAM

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Assemble the equipment listed in Tables 4-1 and 4-2 required for the performance test.		
2	Verify the instrument is set for the correct input line voltage. If required, reset using the procedure in Section 2.		
3	Perform the equipment set-up procedure in paragraph 4-28, selecting 1 volt on 1-volt range and 1 kHz on 1-kHz range.		
4	Are the results satisfactory?	6	5
5	Perform the Switchboard Assembly Test in Table 4-9. Repeat the test in step 3 when completed.		
6	Perform the Output Accuracy Test. Voltages Ranges, paragrpah 4-30.		
7	Are the results satisfactory?	8	10
8	Perform the Output Accuracy Test - Millivolt Ranges, paragraph 4-36.		
9	Are the results satisfactory?	16	10
10	Remove power from the instrument. Wait at least three minutes, then disconnect the Power Amplifier Assembly and install a jumper between tp 4 and tp 5 on the AC-DC Converter Assembly. Apply power to the instrument in the local mode.		
11	Connect an oscilloscope between tp 7 and tp 1 (common) on the oscillator assembly.		
12	Is a signal present, controllable in amplitude and frequency with the Front Panel Magnitude Switches?	13	14
13	Perform the tests in Tables 4-12 Power Amplifier Assembly and 4-11, Attenuator Assembly to isolate the fault. When the tests are complete and any fault located repaired, return to step 6 or step 8 as applicable.		
14	Perform the minor loop tests. This consists of performing the tests in Tables 4-10 Power Supply Assembly, 4-16 Reference Assembly, 4-13 AC-DC Converter Assembly, 4-15 Oscillator Assembly and 4-14 Oscillator Control Assembly. When the tests are complete and any fault located repaired then return to steps 6 or steps 8 as applicable.		
15	Perform the Frequency Output Test, paragraph 4-40.		
16	Are the results satisfactory?	18	19
17	Perform the tests in Tables 4-15 Oscillator Assembly and 4-14 Oscillator Control Assembly. When the tests are complete and any fault located repaired, return to step 15.		
18	Perform the Distortion Tests, paragraph 4-43.		
19	Are the results satisfactory?	21	20
20	Perform the test in Table 4-12 Power Amplifier Assembly beginning at step 99. When the test is complete, and any fault located is repaired, return to step 18.		
21	Perform the Overload Test, paragraph 4-46.		

Table 4-8. MAIN PROGRAM (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
22	Are the results satisfactory?	24	23
23	Perform the tests in Tables 4-12 Power Amplifier Assemlby and 4-11 Attenuator Assembly. When the tests are complete and any fault located repaired, return to step 21.		
24	Perform the Load Regulation Verification Test, paragraph 4-48.		
25	Perform the Line Regualtion Test, paragraph 4-50.		
26	Are the results of both tests satisfactory?	28	27
27	Perform the test in Table 4-11 Attenuator Assembly, beginning at step 19. When the test is complete and any fault located is repaired, return to step 24.		
28	Perform the Phase Lock Test, paragraph 4-52.		
29	Are the results satisfactory?		
30	Perform the tests in Table 4-14 Oscillator Control Assembly beginning at step 84. When the test is complete, and any fault located is repaired, return to step 28		
31	Perform the Quadrature Output Test, paragraph 4-54.		
32	Are the results satisfactory?	34	33
33	Perform the tests in Table 4-14 Oscillator Control Assembly beginning at step 59. When the test is complete, and any fault located is repaired, return to step 31.		
34	Perform the Voltage Error Control Test, paragraph 4-54.		
35	Are the results satisfactory?	37	36
36	Perform the tests in Tables 4-9 Switchboard Assembly beginning at step 47 and 4-16 Reference Supply Assembly beginning at step 22. When the test is complete and any fault located is repaired, return to step 34.		
37	The Performance Test is now complete, if any component was replaced or an adjustment changed, a calibration procedure should be performed.		

Table 4-9 . SWITCHBOARD ASSEMBLY A3

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	If not already done, disconnect Line Voltage from the instrument, remove the top outer cover and the two inner covers.		
2	Verify the proper line voltage switch settings and fuse values. Refer to Section 2, Input Power for detailed instructions if required.		
3	Set the POWER Switch to OFF, the CONTROL Switch to LOCAL, the PHASE LOCK Switch to OFF, the SENSE Switch to INT, and the VOLTAGE ERROR % Switch to OFF. Select 1 volt on the 1-volt range and 1 kHz on the 1 kHz range. Reapply line voltage to the instrument.		
4	Set the POWER Switch to ON.		
5	Does the POWER ON indicator illuminate?	7	6
6	Check the indicator CR37, the +5 volt supplied from the Power Supply and the interconnections through the motherboard.		
7	Does the OVERLOAD indicator illuminate for less than 5 seconds and then extinguish?	9	8
8	The OVERLOAD indicator should illuminate until the ±190 supplies reach their operating points and then extinguish. Check the indicator CR33 and the ±190V Power Supplies on the Power Amplifier.		
9	After a 30 second delay, does the instrument automatically go into STDBY? Are the STDBY and LOCAL indicators illuminated and the OPER and REM indicators extinguished?	11	10
10	If neither indicator operates, check the indicators CR22 and CR23, and the logic gates U3 and U12. If the indicators are reversed, remove the RCU to isolate it from the fault, then check the input logic from the Power Supply (turn on delay) and Attenuator (STANDBY and INT OP) assemblies and that originating from the switchboard Mode Latch.		
11	Exercise the MODE Switch several times to insure the indicators reverse and display the proper status.		
12	Do the indicators reverse with the switch movement and the OPER indicator illuminate when selected?	14	13
13	Check the indicator CR22. Remove the RCU if still installed to isolate the fault from it. Check the Standby logic lines from the Attenuator assembly and back to the switchboard Mode Latch and Remote Circuitry. If the 1000 Volt range is selected or the logic line is low and a 5205A is not connected, the instrument will not go into operate, but remains in Standby.		
14	Is the LOCAL indicator illuminated?	16	15
15	Check CR24 and remove the RCU to isolate it from the fault.		
16.	Exercise the CONTROL Switch several times to insure the indicators reverse and display the proper status.		
17	Do the indicators reverse with the switch movement and the REM indicator illuminate when selected? Do all indicators except Power ON, STDBY, INT and REM extinguish when Remote is selected by the CONTROL Switch?	19	18
18	Check CR24, CR25, S15, U2 and U3.		

Table 4-9. SWITCHBOARD ASSEMBLY A3 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
19	Is the PHASE LOCK indicator extinguished?	21	20
20	Check U2, U3 and for fault creating low from the RCU.		
21.	Exercise the PHASE LOCK Switch several times.		
22.	Does the Phase Lock ON indicator illuminate when selected and extinguish when PHASE LOCK OFF is selected?	24	23
23	Check CR26, U2, U3, S16 and the enabling voltage from the Local circuit (LOCAL).		
24.	Is the SENSE INT. indicator illuminated and the EXT indicator extinguished?	26	25
25	Remove the RCU to isolate it from the problem. Check the sense logic on the Attenuator assembly, (U13, U14, U15 and U17.) Check U3, S17 and the indicators CR27 and CR28 on the Switchboard assembly.		
26	With the MODE Switch to STDBY, set the SENSE Switch to EXT. Verify the INT indicator stays illuminated.		
27	Set the MODE Switch to OPER, then exercise the SENSE Switch several times to insure the indicators reverse and display the selected status.		
28	Set the MODE Switch to OPER and the SENSE Switch to EXT. Check that the SENSE indicator automatically returns to internal sensing when any millivolt range is selected. Return the voltage range to the 1-volt range and verify the sense circuit automatically returns to external sensing.		
29	Are the three previous checks as stated?	31	30
30	The circuitry controlling these indications is located on the Attenuator assembly with the exception of the SENSE Switch S17, the U3 inverter and the diodes CR27 and CR28 which are on the switchboard assembly. The input at J11H/U3-5 should remain low if external sensing is selected in standby or drop low if any millivolt range is selected. If not, check the BCD to decimal converter U10 and its associated Logic gates U13, U14, U15 and U17. Repair as required, then repeat the test, starting at step 28.		
31	Vary the VOLTAGE RANGE Switch through its seven positions insuring the correct decimal point indicator illuminates.		
32	Does CR32 (left extreme) illuminate when the 1-mV and 1-Volt ranges are selected? CR31 (left center) for the 10-mV and 10-Volt ranges, CR30 (right center) for the 100-mV and 100-Volt ranges and CR29 (right extreme) for the 1000-Volt range?	34	33
33	Check the indicators, U4, U6 and S7 using the truth table on the schematic, Figure 8-3. Insure the CONTROL Switch is in the Local position and the LOCAL logic line low. Insure the inputs to U4 are not grounded from a source external to the input, such as, the RCU, the Attenuator assembly or the switchboard internal sense relay circuit. Remove the RCU to isolate it from the fault. On the truth table O is the equivalent of a logic high and C of a logic low.		
34	Vary the FREQUENCY RANGE Hz Switch through its five positions insuring the correct decimal point indicator illuminates.		
35	Does CR34 (left) illuminate when the 1 kHz and 1 MHz ranges are selected? CR35 (center) for the 10 kHz range and CR36 (right) for the 100 Hz and 100 kHz ranges?	37	36

Table 4-9. SWITCHBOARD ASSEMBLY A3 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
36	Check the indicators, U1, U5 and S13 using the truth table on the schematic, Figure 8-3. Insure the CONTROL Switch is in the LOCAL position and the LOCAL logic line low. Insure the inputs to U5 are not grounded from a source external to the input, such as, the RCU or the switchboard INTOP circuitry. Remove the RCU to isolate it from the fault if any question arises.		
37	The frequency range logic is not fed directly to other assemblies as in the Voltage Range circuit, therefore, the fact that the decimal point indicators are operational is not sufficient proof that the frequency range is reaching the remaining circuits. The Logic is latched by U8 and U9, decoded by U7 and then routed to the Attenuator and Oscillator control assemblies. One way to verify the Frequency Range output is to put the Oscillator Control assembly on an extender and use the frequency range truth table to check the INTOP circuit outputs. Substitute extender pin 26 for C1, pin 28 for C2 and pin 30 for C4 in the table. In addition, O is the equivalent of a logic high and C of a logic low.		
38	Connect a rms differential voltmeter to the 5200A output terminal.		
39	Vary each of the voltage magnitude switches in turn, while observing the output.		
40	Does the output change in proportion to the movement of the Voltage Magnitude Switches?	42	41
41	The voltage magnitude switch outputs are not readily accessible for testing. They can be reached with the AC-DC Assembly on an extender for the LSD of magnitude and the Reference Assembly on the extender for the five MSD's. With the AC-DC Converter in the extender, check at extender pins 21, 23, 25 and 27 for AMPTD1, AMPTD2, AMPTD4 and AMPTD8 respectively. The signal present should be the BCD equivalent of the number displayed on the magnitude LSD switch. With the Reference assembly in the extender check the MSD at extender pins 42 (AMPTD100K), 44 (AMPTD200K), 50 (AMPTD400K) and 52 (AMPTD800K). Check the second MSD at extender pins 34 (AMPTD10K), 36 (AMPTD20K), 38 (AMPTD40K) and 40 (AMPTD80K). Check the third MSD at extender pins 26 (AMPTD1K), 28 (AMPTD2K), 30 (AMPTD4K) and 32 (AMPTD8K). Check the fourth MSD at extender pins 18 (AMPTD 100), 20 (AMPTD 200), 22 (AMPTD 400) and 24 (AMPTD 800). Check the fifth MSD at extender pins 10 (AMPTD 10), 12 (AMPTD 20), 14 (AMPTD 40) and 16 (AMPTD 80). In all cases the output of an individual MSD switch as monitored at the Reference Assembly should be the complemented BCD equivalent of the switch setting. Verify the voltage magnitude switches are operational before continuing.		
42	Connect a frequency counter to the 5200A output terminals.		
43	Select the 1KHz range and vary each of the frequency magnitude switches in turn while observing the output.		
44	Does the output frequency change in proportion to the movement of the frequency magnitude switches?	46	45
45	The frequency magnitude switch outputs are not readily accessible for testing. They can be reached conveniently by placing the oscillator assembly on an extender board. The MSD outputs can be read on extender pins 62 (FREQ 1K), 64 (FREQ 2K), 66 (FREQ 4K) and 68 (FREQ 8K). The output at switch settings 1 through 7 will be standard BCD. Counts 8, 9, 10 and 11 use FREQ 8K as an additional 4 count so that both pins 66 and 68 are true for these counts. The BCD output should be equal to the figure displayed on the front panel switch. The second MSD on extender pins 54 (FREQ 100), 56 (FREQ 200), 58 (FREQ 400) and 60 (FREQ 800) should output a standard BCD code equal to the front panel switch setting. The same is true of the third MSD at Pins 42 (FREQ 10), 44 (FREQ 20), 50 (FREQ 40) and 52 (FREQ 80), and the LSD of pins 34 (FREQ 1), 36 (FREQ 2), 38 (FREQ 4) and 40 (FREQ 8). Logic True for this test is −15V from the logic circuitry and the oscillator assembly. Lgoic Low is approximately +0.6 Volts from the Q1 collector voltage on the switchboard. Verify the frequency magnitude switches are operational before continuing.		

Table 4-9. SWITCHBOARD ASSEMBLY A3 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
46	Check the Voltage Error - % circuit by removing power and then disconnecting the Reference and Power Amp assemblies. Install the extender in place of the Reference assembly to give access to test points not convenient to reach on the switchboard. Reapply power to the instrument and set the CONTROL Switch to LOCAL and the MODE switch to STDBY.		
47	Check with an ohmmeter for approximately 100K ohms between extender pins 60 and 62.		
48	Set the VOLTAGE ERROR - % Switch to X1 and check between extender pins 64 and 68 for a smooth change in resistance as the VERNIER is moved from one extreme to the other.		
49	Set the VOLTAGE ERROR - % Switch to X.1 and check between extender pins 64 and 66 for a smooth change in resistance as the VERNIER is moved from one extreme to the other.		
50	Are all the Voltage error % checks acceptable?	52	51
51	Check the VERNIER resistor R21, K1 contacts and the interconnections. This is a resistance check only to verify smooth operations. An electrical check of the system is made during checks of the Reference Assembly.		
52	Remove Power from the instrument. Install the attenuator assembly using the extender kit pcb and cables. Placing the attenuator on the extender provides access to signals not readily accessible on the switchboard assembly. Reconnect the Reference and Power Amp assemblies.		
53	When power is reapplied to the instrument, is there a delay of approximately 30 seconds before the STDBY indicator illuminates?	55	54
54	Check the 30 second turn on delay (physically located on the Power Supply Mother Assembly) consisting of U5 and its associated components. Repair as required then repeat step 53.		
55	Set the MODE Switch to OPER, then change the Frequency Range.		
56	Does the instrument momentarily drop in status to standby?	58	57
57	Check the pulse generating circuit U7, U8, U9, U10 and U11 on the Switchboard Assembly. Repair as required, then repeat step 55.		
58	Connect an oscilloscope to extender pins 32 and 86 (common). A logic high should be present.		
59	Does the logic signal go low in approximatley 20 msec when the POWER switch is set to OFF? (This check insures no transient spikes from Power Supply fade down appear at the output to damage equipment connected to the 5200A, if input power is lost.)	61	60
60	Check Q18, C26 and their associated components on the Power Supply Mother Assembly. If C26 becomes leaky, the instrument will alternate in status between operate and standby. Repair as required, then repeat step 58.		
61	Remove power from the instrument. Wait at least three minutes then replace the Attenuator Assembly and remove the Power Amplifier Assembly. Remove any shorting links or external connections from the output terminals.		
62	Reapply power and after the 30 second delay, while in STDBY, select internal sensing. Measure with an ohmmeter between Output High and Sense High, then between Output Low and Sense Low.		
63	Are both readings close to zero ohms?	65	64

Table 4-9. SWITCHBOARD ASSEMBLY A3 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
64	Check the sense relay K3 and its associated logic gates. Repair as required then repeat step 62.		
65	Select the 100 Volt range then set the SENSE switch to EXT and the MODE switch to OPER.		
66	Recheck the resistance readings between the Output and Sense terminals.		
67	Do both readings reflect a diode junction indication for both ohmmeter polarities?	69	68
68	The diodes separating the sense from the output terminals are physically located on the Attenuator assembly. Load regulation faults can be causedwhen these diodes are either shorted or open. Repair as required then repeat step 65.		
69	Remove power from the instrument. Replace any assemplies removed or on an extender, and then install both top inner covers. Remove any shorting links or external connections from the output terminals.		
70	Measure from the guard terminal to the ground terminal.		
71	Is the guard to ground reading greater than 10 Megohms?	73	72
72	Check for physical damage or debris that would bring the chassis in contact with the guard. Repair or remove as required and repeat step 70.		
73	Measure from the guard terminal to the inner covers.		
74	Is the guard to inner cover approximately 12 ohms?	76	75
75	Check the components (R27/L1) between the terminal and the covers then repeat step 73.		
76	Replace the outer covers on the instrument.		
77	Measure from the guard terminal to the outer cover.		
78	Is the guard to outer cover reading greater than 10 megohms?	80	79
79	Check in particular for physical damage that would bring the inner and outer covers into contact. Repair as required then repeat step 77.		
80	Measure from the ground terminal to the outer cover and to the powerline center connector.		
81	Is the reading between the ground terminal and both the power line center connector and the outer covers virtually zero?	83	82
82	Check for an open between the power line, chassis and front terminals. This passes through the motherboard. Repair as required then repeat step 80.		
83	The test of the switchboard assembly is now complete. If R21 was replaced the Error Control Calibration procedure should be performed.		

Table 4-10. POWER SUPPLY ASSY A5

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Prior to beginning this test the top outer and inner covers must be removed, an autotransformer must be connected between the instrument and line power and adjusted for the proper input, the fuse and its rating should be checked, and the position of the voltage selection switches must be checked for the applicable input voltage as shown in Section 2.		
2	Insure the POWER switch is OFF, the CONTROL Switch to LOCAL, the PHASE LOCK switch to OFF, the SENSE switch to INT, the VOLTAGE ERROR % switch to OFF and outputs of 1 Volt on the 10 Volt range and 1 kHz on the 1 kHz range are selected.		
3	Install the A5A2 Power Supply Regulator on an extender board. **WARNING** **When the 5200A Power Switch is ON, dangerous Voltages up to ±300V dc are present on some extender pcb test points.**		
4	Verify the Line Voltage cord is connected, then set the POWER switch to ON.		
5	Make the following voltage checks of the standard inside the guard regulators (+5, +15, −15, +30, and −30) using pin 51 of the extender board connector as common (LO).		
6	Connect the HI input of the differential voltmeter to extender pin 57.		
7	Adjust R32 for an output of +15 ±0.1 Volts.		
8	Can the voltage be adjusted within tolerance?	9	84
9	Using the autotransformer vary the input line voltage ±10%.		
10	Does the rgulator output change less than ±5 m Volts?	11	86
11	Connect the oscilloscope to pins 57 (HI) and 51 (LO) and vary the line voltage ±10%.		
12	Is the maximum peak-to-peak ripple less than 10 m Volts.	13	86
13	Transfer the differential voltmeter and oscilloscope HI inputs to extender pin 59.		
14	Does the regulator output read −15 ±1.0 Volt?	15	86
15	Using the autotransformer vary the input line voltage ±10%.		
16	Does the regulator output change less than ±20 m Volts?	17	86
17	Is the maximum peak-to-peak ripple less than 10 m Volts?	18	86
18	Transfer the differential voltmeter and oscilloscope HI inputs to extender pin 55.		
19	Does the regulator output read +30 ±1.0 Volts?	20	86
20	Using the autotransformer, vary the input line voltage ±10%.		
21	Does the regulator output change less than ±10 m Volts?	22	86
22	Is the maximum peak-to-peak ripple less than 10 m Volts?	23	86
23	Transfer the differential voltmeter and oscilloscope HI inputs to extender pin 53.		
24	Does the regulator output read −30 ±1.0 Volts?	25	86

Table 4-10. POWER SUPPLY ASSY. A5 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
25	Using the autotransformer, vary the input line voltage ±10%		
26	Does the regulator output change less than ±10 mVolts?	27	86
27	Is the maximum peak-to-peak ripple less than 10 m Volts?	28	86
28	Transfer the differential voltmeter and oscilloscope HI inputs to extender pin 68.		
29	Does the regulator output read +5 ±0.25 Volts?	30	86
30	Using the autotransformer vary the input line voltage ±10%		
31	Does the regulator output change less than ±10 m Volts?	32	86
32	Is the maximum peak-to-peak ripple less than 5 m Volts?	33	86
33	Make the following voltage checks of the floating inside the guard regulators (+15 (F), −15 (F) and +20 (F)) using pin 43 of the extender board connector as common (LO).		
34	Connect the differential voltmeter HI input to extender pin 38 and the oscilloscope HI input to extender pin 37.		
35	Does the regulator input read +6.955 ±0.005 volts?	36	39
36	Using the autotransformer, vary the input line voltage ±10%		
37	Does the regulator input change less than ±5 m Volts?	38	39
38	Is the maximum peak-to-peak ripple less than 20 m Volts?	40	39
39	Check the interconnections on the A5 and A2 Motherboards and the A12 Reference Supply. The Reference Supply can be isolated by using an input from an external floating supply at pin 38, however, the common from the floating supply must be connected to both pins 41 and 43. The +20 (F) is used on the Reference Assembly to generate the 6.955V input. Repair the applicable assembly as required then repeat step 35.		
40	Transfer the differential voltmeter and oscilloscope HI inputs to pin 39 on the extender board (or the equivalent A5A2TP12).		
41	Does the regulator output read +20 ±0.25 Volts?	42	86
42	Using the autotransformer vary the input line voltage ±10%.		
43	Does the regulator output change less then ±100 m Volts?	44	86
44	Is the maximum peak-to-peak ripple less than 50 m Volts?	45	86
45	Transfer the differential voltmeter and oscilloscope HI inputs to pin 34 on the extender board (or the equivalent A5A2TP 10).		
46	Does the regulator output read +15 ±0.1 Volts?	47	86
47	Using the autotransformer, vary the input line voltage ±10%		
48	Does the regulator output change less than ±10 m Volts?	49	86

Table 4-10. POWER SUPPLY ASSY. A5 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
49	Is the maximum peak-to-peak ripple less than 20 m Volts?	50	86
50	Transfer the differential voltmeter and oscilloscope HI inputs to pin 35 on the extender board (or the equivalent A5A2TP 11).		
51	Does the regulator output read −15 ±0.5 Volts?	52	86
52	Using the autotransformer, vary the input line voltage ±10%		
53	Does the regulator output change less than ±10 m Volts?	54	86
54	Is the maximum peak-to-peak ripple less than 20 m Volts?	55	86
55	The High Voltage tests that follow should begin with all pcbs installed (A5A2 pcb installed on the extender pcb) except the Power Amplifier A7. If the instrument is not in this configuration, remove power, wait at least three minutes, install or remove the pcbs as required, then reapply power. **WARNING!** **Extreme caution must be exercised when checking the ±300 and ±190 RAW Voltage supplies. Lethal voltages are present on the extended board test points. In addition, since there is no current limiting other than the line fuse, grounding one of the test points with a test lead can short out the supply and may burn out the inter-connecting lands on the Power Supply Assembly A5 or the Extender board.**		
56	Connect the DVM LO input to the extender board pin 26. This point is common for all the High Voltage tests. *NOTE* *The tollerances listed in the following High Voltage checks are dependent upon the line voltage being within tolerance since there is no line regulation for these supplies.*		
57	With the DVM HI input check at extender pin 29 for +350 ±35 Volts dc, pin 21 for −350 ±35 volts dc, pin 27 for +270 ±30 Volts dc, and pin 23 for −270 ±30 Volts dc.		
58	Are all voltages present and within tolerance?	60	59
59	Check the applicable filter, rectifiers and transformer secondaries. Repair as required, then repeat step 57.		
60	Remove power from the instrument, wait at least three minutes, then install the Power Amplifier A7 and reapply power to the instrument.		
61	With the DVM HI input check at extender pin 29 for +325 ±30 Volts dc, pin 21 for −325 ±30 Volts dc, pin 27 for +250 ±30 Volts dc, and pin 23 for −270 ±30 Volts dc.		
62	Are all voltages present and within tolerance?	64	63
63	Check the Power Amplifier A7 and the interconnections for loading. Repair as required, then repeat step 61.		
64	Set the POWER switch to OFF and wait at least three minutes before continuing.		

Table 4-10. POWER SUPPLY ASSY A5 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
65	Remove the Power Supply Regulator pcb A5A2 from the extender pcb and return it to its slot. Install the Power Supply pcb A5A1 in the extender pcb. Verify all other pcb's are installed in the instrument.		
66	Set the POWER switch to ON and the MODE switch to STDBY.		
67	Make the voltage checks of the outside the guard regulator (+5V (O), +15 (O), and −15 (O), using tp1 on the Power Supply pcb as common.		
68	Connect the differential voltmeter and oscilloscope HI inputs to extender pin 40.		
69	Does the regulator output read +5 ±0.5 Volts?	70	86
70	Was the voltage Regulator U4 replaced?	95	71
71	Using the autotransformer, vary the input line voltage ±10%		
72	Does the regulator output change less than ±50 m Volts?	73	86
73	Is the maximum peak-to-peak ripple less than 5 m Volts?	74	86
74	Transfer the differential voltmeter and oscilloscope HI inputs to tp3 on the Power Supply pcb.		
75	Does the regulator output read +15 ±1.0 Volts?	76	86
76	Using the autotransformer, vary the input line voltage ±10%		
77	Does the regulator output change less than 500 m Volts?	78	86
78	Is the maximum peak-to-peak ripple less than 20 m Volts?	79	86
79	Transfer the differential voltmeter and oscilloscope HI inputs to tp4 on the Power Supply pcb.		
80	Does the regulator output read −15 ±10 Volts?	81	86
81	Using the autotransformer, vary the input line voltage ±10%.		
82	Does the regulator output change less than 300 m Volts?	83	86
83	Is the maximum peak-to-peak ripple less than 10 m Volts;	97	86
84	Check the input to the power supply, the fan and thermal switch for over-heating, the voltage selection switches, and the transformer primary.		
85	Is the fault isolated?	90	86
86	Check the applicable transformer secondary, bridge rectifier, regulator circuit and interconnections.		
87	Is the fault isolated?	90	88
88	Check for loading from other circuit boards by removing the pcbs one at a time while monitoring the effected regulator output. Insure the POWER switch is set to OFF before removing any pcb and always begin with the A7 Power Amplifier.		
89	If one of the other circuit boards is loading down the regulator, refer to the applicable procedure. When the loading is removed, return to the step that originated the transfer.		

Table 4-10. POWER SUPPLY ASSY A5

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
90	Replace the component found defective.		
91	If the Load regulation of the standard voltage regulators inside the guard are to be checked, go to step 92, for the floating voltage regulators inside the guard, go to step 93 and for the outside the guard regulators, go to step 94.		
92	Check the standard inside the guard regulators using the checks in Table 4-17. All pcbs should be removed from the instrument when making these checks except the A5 Power Supply Assembly which includes the A5A1 Power Supply PCB, the A5A2 Power Supply Regulator pcb and the A5A3 Transformer pcb. The load may be placed across the extender board test pins listed in the table. If a 2 Watt carbon resistor is used for the load, leave connected only long enough to measure the regulation. When the test is complete, repair as required and recheck the inside the guard regulators beginning at step 5.		
93	Check the floating inside the guard regulators using the checks in Table 4-18. All pcbs should be removed from the instrument except for the Power Supply Mother A5 with its associated sub-boards A5A1 Power Supply pcb, A5A2 Power Supply Regulator pcb and A5A3 Transformer pcb, and the A12 Reference Assembly. The instrument should have at least ten minutes warmup prior to performing the checks. For proper grounding, connect a clip lead from the output cable shield of the Reference Supply to pin 43 on the extender and a clip lead connecting pins 41 and 43. If the 6.955 reference is questionable, this voltage can be supplied from an external source to pin 38, however, insure the external supply is stable, that pins 41 and 43 are connected to the external supply LO which must be floating and the Reference Assembly disconnected from the instrument. In addition to the Reference Supply, the +15 (F) regulator is used as a reference for the other three supplies. Even though the −20 Volt supply is not used, its presence should be checked since it can effect the other supplies if shorted. The loads may be placed directly on the extender pins, however, they should be left connected only the minimum time required to obtain a reading. When the test is complete, repair as required and recheck the floating inside the guard regulators, beginning at step 33.		
94	Check the outside the guard regulators with the Power Supply pcb A5A1 on the extender board using the checks in Table 4-19. All pcbs should be removed from the instrument except the Power Supply Mother A5 with its associated sub-boards A5A1 Power Supply pcb, A5A2 Power Supply Regulator pcb and A5A3 Transformer pcb. The instrument should have at least ten minutes warmup prior to performing the checks. Leave the load connected only the minimum time required to obtain the readings. When the test is complete, repair as required and recheck the outside the guard regulators beginning at step 67.		
95	Connect a DVM between U4-4 (HI) and TP 1 (LO).		
96	Compare the voltage reading to the figures in Table 4-20. Select the applicable value of R6 and compare to the installed component. If not correct, install the correct value and verify the regulator output is equal to +5 $\pm$0.5 Volts. When complete, go to step 71.		
97	Test of the Power Supply Assembly is complete. The 30 second delay and INT OP circuits are physically located on the assembly but are checked during the Switch Assembly Test in Table 4-9.		

Table 4-11. ATTENUATOR ASSEMBLY A6

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Remove Power from the instrument. Wait at least three minutes, then remove the attenuator assembly, install it on the extender pcb and reinstall the combination in the instrument. Insure that all other standard assemblies are installed in the instrument and the coaxial conhex connector cables are connected. **WARNING!** **When the 5200A is in Standby, dangerous voltages of ±300V dc are present on some extender pcb test points.**		
2	Set the POWER Switch to ON.		
3	Using extender pin 81 as common, check with a DVM at extender pin 84 and J32, pin 7 (top rear card edge connector) for +5 ± .25V dc. **CAUTION!** **The Attenuator Assembly is a multilayered pcb. When removing components for replacement during troubleshooting, the preferred method is to clip the leads, especially with IC's, and remove them one at a time to prevent removing the thru hole plating.**		
4	Is the voltage present and within tolerance at both points?	6	5
5	If present at pin 84, but not at J32-7, check the pcb for open land patterns. If not present at either point, check the power supply output and for loading.		
6	Verify the MODE Switch is in STDBY, then while selecting all of the various Frequency/Voltage range combinations, check if the OVERLOAD or OPER indicators illuminate.		
7	Did the OVERLOAD indicator illuminate at any Frequency/Voltage range combination?	8	12
8	While set at the defective Frequency/Range combination, remove the conhex connectors for the coax cables to the Power Amplifier and AC-DC converter.		
9	Did the OVERLOAD indicator stay illuminated?	10	11
10	Check the LIMIT Logic circuits on the Power Amplifier and/or AC-DC converter for the overload using the applicable tables. When complete, repeat the test beginning with step 6.		
11	The most probable cause of an overload originating on the attenuator is more relays than required closed, providing parallel signal paths and loads. Use Tables 4-21 and 4-22 as an aid in tracing signal flow. Also, check the assembly for shorted land patterns or components. Repair as required and repeat the test beginning with step 6.		
12	Did the OPER indicator illuminate at any Frequency/Voltage range combination?	15	13
13	Set the Voltage range switch to 1 volt and the MODE switch to OPER.		
14	Does the OPER indicator illuminate and the STDBY indicator extinguish?	16	15
15	Check the STANDBY logic line at extender pin 34 and the logic gates originating the signal. Repair as required and repeat the step causing the transfer to this step.		
16	Select both Internal and External Sensing at each Voltage range.		

Table 4-11. ATTENUATOR ASSEMBLY A6 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
17	Is the sense switching correct, i.e., only internal selectable in the three millivolt ranges and both Internal and External selectable in the other ranges?	19	18
18	Check the EXT SEN logic line at extender pin 43 and the logic gates originating the signal. Repair as required and repeat the test beginning at Step 16.		
19	Perform the Load Regulation Verification Test in paragraph 4-48.		
20	Perform the Line Regulation Test in paragraph 4-50.		
21	Are the results of both tests acceptable?	24	22
22	A failure in the sense lines is a frequent cause of failure in the line and/or load regulation circuits. This can be checked by removing the Power Amp and selecting the 100-volt range, external sense and operate. Measure with an ohmmeter between the output high and sense high terminals, and then between the output low and sense low terminals. There should be a diode junction voltage drop in both polarities on each set of terminals. An open or short in any of these measurements will cause a failure. When completed, select internal sensing and measure for a short between each set of terminals. An open or diode junction voltage drop during these measurements will cause a failure. A complete check of the sensing relay is contained in Table 4-9, step 61.		
23	Replace the Power Amp, repair any components found defective and then recheck the Line and Load regulation as described in paragraphs 4-48 and 4-50. If the instrument still does not pass those tests, perform the Signal Path Test Subroutine beginning at Step 34. When the subroutine is completed, return to the procedure at step 19.		
24	Perform the Distortion Tests in paragraph 4-43.		
25	Are the results of the test acceptable?	29	26
26	Check for an overload condition on the Power Amp Assembly. If present, refer to step 6. If applicable, repair as required and repeat step 24.		
27	Check for the same distortion at the input from the Power Amplifier. If present, check the Power Amplifier, using the applicable table. If applicable, repair as required and repeat step 24.		
28	The distortion may be caused by problems in the signal paths through the relays. Perform the signal Path Test subroutine beginning at step 34. When the subroutine is completed, return to the procedure at step 24.		
29	Connect a rms differential voltmeter across the 5200A output terminals. Connect the instrument for external sensing. Select external sensing on the 5200A Front Panel.		
30.	Excercise the Front Panel Frequency and Voltage range switches up to a maximum of 10 volts, 1 MHz several times to check the repeatability and stability of the output signal.		
31	Is the stability and repeatability of the output of an acceptable quality?	33	32
32	Perform the Signal Path Test sub routine beginning at step 34. When the subroutine is completed, return to the procedure at step 29.		
33	The test of the Attenuator Assembly A6 is now complete. If any component was replaced or an adjustment changed, a calibration procedure should be performed.		
34	Signal Path Test Subroutine. Three different methods can be used to provide a signal source to trace the signals through the Attenuator Assembly. Each method is described in one of the three following steps. Select the method best suited for the conditions at the time the test is performed.		
35	The first method uses the output from the Power Amp and the front Panel Controls but removes the attenuator sense output. Verify the attenuator assembly is on the extender and connected to the Power Amp Output with an extension cable. Remove the Attenuator Sense Output cable from the AC-DC Converter. Short tp4 to tp5 on the AC-DC Converter (the OVERLOAD indicator will illuminate but will not effect operations). The instrument is now ready for the test which starts at step 38, however, remember that while the Power Amp input is controlled, the output is not and will vary slightly from normal readings.		

Table 4-11. ATTENUATOR ASSEMBLY A6 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
36	The second method uses the Oscillator Output and the Front Panel controls but removes the Power Amp from the circuit. Disconnect the Power Amp from the instrument. Verify the attenuator assembly is on the extender. Remove the Attenuator sense output cable from the AC-DC converter and short tp4 to tp5 on the AC-DC Converter (the OVERLOAD indicator will illuminate but will not effect operations). Connect the oscillator assembly output at tp7 (HI) and tp1 (LO) to the Attenuator input at the conhex connector, J33. Set the Front Panel Voltage magnitude switches to full scale. The instrument is now ready for the test which begins at step 38, however, the maximum signal will be approximately 3 volts rms.		
37	The third method uses an external oscillator to remove any possibility of the error being induced by the Oscillator of Power Amp assemblies. Verify the Attenuator assembly is on the extender. Remove the Attenuator sense output cable from the AC-DC Converter. Disconnect the Power Amplifier and Oscillator assemblies. Connect the output of an external oscillator set for some frequency within the range dialed by the Front Panel and between 1 and 12 volts rms to the attenuator input at the conhex connector J33. If the 100-volt range is selected in the OPERATE mode, an input of 10 to 120 volts may be used. However, if more than 12 volts is applied while the instrument is in any other range, or in the 100-volt range, while in standby damage to the attenuator components may result.		
38	Trace the applied signal through the paths given in tables 4-21 and 4-22. If any signal path is not complete, use Table 4-23 to check the logic controlling the Frequency range and Table 4-24 to check the logic controlling the voltage Amplitude range. Verify the relay coils and contacts are operational prior to testing the energizing logic circuits. Check that the attenuator sense output cable always has available between 0.1 to 1.2 volts rms for the AC-DC Converter. *NOTE* *A logic HIGH or true can result from an open circuit in addition to the normal +2.0 to +5.0 volts dc.*		
39	Repair as required, repeat the test until the results are satisfactory, then return to the step originating the transfer to this sub-routine.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Remove power from the instrument. Wait at least three minutes, then disconnect the Power Amp from the Motherboard, install it on the extender assembly and reinstall the combination in the instrument. Do not reconnect the attached coaxial cable to J33 on the Attenuator assembly. Set S1 to the position the white dot is visible to lower the output stage operating voltages. Rotate R26 BIAS CURRENT ADJUST fully counter clockwise for minimum bias. Connect a test voltmeter between tp OUTPUT (HI) and tp 6 LOW. Disconnect the Oscillator Assembly A10 from the instrument for the voltage regulator checks.		
	WARNING! **When the 5200A POWER Switch is ON, dangerous voltages up to ± 300 Volts DC are present on some extender pcb test points.**		
2	Set the POWER Switch to ON and after the delay, the MODE switch to STDBY.		
3.	Does the test voltmeter read a DC Zero offset of 0 ±0.5V dc?	4	5
4	If the DC offset voltage is within tolerance and the instrument fault has not yet been isolated to the power amplifier the power supply checks that follow may be omitted at the operator's discretion and the test transferred to step 45. If the instrument fault has been isolated to Power Amplifier or a fault develops in later steps of this procedure, the power supply checks contained in steps 5 through 44 should be performed.		
5	Connect the DVM between extender pins 21 (HI) and 17 (LO) and check the +300 for a reading between +295 and +355V dc.		
6	Transfer the DVM HI input to extender pin 13 and check the −300 for a reading between −295 and −355V dc.		
7	Transfer the DVM HI input to extender pin 16 and check the −190 RAW for a reading between −220 and −280V dc.		
8	Transfer the DVM HI input to extender pin 19 and check the +190 RAW for a reading between +220 and +280V dc.		
9	Transfer the DVM HI input to extender pin 76 and the LO input to pin 86. Check the +30V for a reading between +29 and +31V dc.		
10	Transfer the DVM HI input to extender pin 74 and check the −30V for a reading between −29 and −31V dc.		
11	Transfer the DVM HI input to extender pin 77 and check the −15V for a reading between −14 and −16V dc.		
	NOTE *The +15V dc is adjusted to the listed tolerance during calibration. It might then be readjusted out of the listed tolerance to insure the +190 Volts regulated checked later in the procedure is at least +185V dc.*		
12	Transfer the DVM HI input to extender pin 79 and check the +15V for a reading between +14.9 and +15.1V dc.		
13	Transfer the DVM HI input to extender pin 83 and check the +5V for a reading between +4.75 and +5.25V dc.		
14	Are all the externally supplied voltages within tolerance?	24	15
15	Remove power from the instrument, wait at least three minutes, then remove the Power Amplifier Assembly from the extender assembly, and reapply power to the instrument.		
16	Repeat the voltage checks in steps 5 through 14 with the Power Amplifier Assembly removed.		
17	Are all the voltages now within tolerance?	18	19

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
18	Check the Power Supply Assembly output and the insteconnections using the applicable tables. Repair as required and repeat the voltage checks beginning with step 1.		
19	If the plus and minus 15 or 30 Volts supplies are defective, due to loading on the Power Amp, check the ±190V regulator circuits, the −21 Volt circuit, the Output Stage transistors, shorted land patterns, oscillation on the output or a dc offset on the output.		
20	For loading in the +5 Volt circuit, check K1, K2, Q13, U2 and the land patterns.		
21	For loading of the ±300 Volt supplies, check at CR8 and CR9 for +10 ±1V dc and −10 ±1 V dc respectively. If present, check the output stage.		
22	The ±190 RAW inputs are used to generate the ±190 Regulated Supplies. Check these circuits for loading if the input is loaded down sufficient to be defective.		
23	Repair any faults located and repeat the power supply checks starting at step 2.		
24	With the DVM connected between tp 1 (HI) and tp6 (LO) does the −190 Regulated voltage read between −180 and −200 volts?	28	25
	CAUTION **High Voltage is present at the test points in the following procedure: When testing with the load, do not leave it connected for more than 5 seconds and use a high wattage resistor box such as the clarostat, power resistor decade box, Model 240-C or equivalent.**		
25	Check the regulation of Q31, Q32, CR12, Q30 and Q29 and their associated components, then verify the circuit as follows: With a scope connected between tp1 and tp6, the ripple should be less than 10 mV p-p. Apply a 4k ohm load between tp6 and the negative (bottom end) of C20 and check for a change in voltage with the load applied at less than 500 mV. The ripple with the load applied should not exceed 10 mV. With the line voltage varied ±10%, the regulated voltage should not vary more than 500 mV p-p with no load and 700 mV with the 4K ohm load applied.		
26	Check the limiting of Q40 and its associated components, then verify the circuit as follows: With a scope connected between tp1 and tp6, the ripple should be less than 10 mV p-p. Apply a 1 K ohm load between tp 6 and the negative (bottom) end of C20 and check for a change in voltage of greater than 10 Volts.		
27	Repair as required and then repeat step 24		
28	With the DVM HI input transferred to tp2, does the −190 Limit Voltage read between −180 and −200V dc?	31	29
29	Check the limiting of Q19, Q24 and their associated components for the output stage supply, then verify the circuit as follows: With a scope connected between tp 2 and tp 6, the ripple should be less than 10 mV p-p. Apply a 1.3K ohm load between tp6 and the collector of Q24 and check for a change in voltage of greater than 2 volts. With the line voltage varied ±10%, the −190 limit voltage should not vary more than 500 mV unloaded.		
30	Repair as required, then repeat step 28.		
31	With the DVM HI input transferred to the negative (top) end of C35, does the −190 bias supply read between −180 and −200V dc?	34	32

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
32	Check Q41, Q42 and their associated components for the −190 bias supply, then verify the circuit as follows: With a scope connected between the negative end of C35 and tp 6, the ripple should be less than 5 mV p-p. Apply a 7K ohm load between the negative end of C35 and tp6 and check for a change in voltage of greater than 2 volts. With the line voltage varied ±10%, the −190 bias voltage should not vary more than 500 mV unloaded.		
33	Repair as required, then repeat step 31.		
34	With the DVM HI input transferred to junction R72 and the collectors of Q6 and Q8, does the DVM read between −20 and −22V dc?	37	35
35	For a fault in the −21 volt circuit, check CR1, CR3, Q7 and Q8, and the differential amp transistors Q3, Q4, Q5 and Q6. The collector of Q2 should be at approxiamtely +6.5 Volts except when the −100 volt range is selected. The collector of Q7 should be approvimately 28.4 volts and the emitters of Q3 and Q4 should be close to equal and between 0.7 and 1.8 volts. The gate of Q1 should be 0 ±100 μ Volts, however, at least a 10K ohm resistor should be used in series with the voltmeter probe to prevent oscillation.		
36	Repair as required then repeat step 34.		
37	With the DVM HI input transferred to tp 3 does the +190 Regulated Supply read between +185 and +200V dc.	41	38
38	Check the regulation of Q25, Q26, Q28 and their associated components then verify the circuit as follows: With a scope connected between tp3 and tp6, the ripple should be less than 100 mV p-p. Apply a 4K ohm load between the Cathode of CR32 (Q27 Emitter convenient equivalent) and tp 6 and check for a change in voltage of less than 500 mV. The ripple with the load applied should not exceed 100 mV. With the line voltage varied ±10%, the regulated +190 Volts should not vary more than 1 volt with or without the 4 K ohm load applied.		
39	Check the limiting of Q27 and its associated components, then verify the circuit as follows: With a scope connected between tp3 and tp6 the ripple should be less than 100 mV p-p. Apply a 1.3K ohm load between the Cathode of CR32 and tp6 and check for a change in voltage of greater than 50 volts.		
40	Repair as required then repeat step 37.		
41	Recheck the zero dc offset between tp OUTPUT (HI) and tp 6 for 0 ±100 μ Volts.		
42	Is the offset within tolerance now that all the regulated power supplies have been verified?	45	43
43	Try to bring within tolerance by adjusting R6 PWR AMP ZERO. If insufficient range exists check the main signal and main feedback paths through the Power Amplifier. Check the Op Amp U1. CR29 and C29 at the input or Q38, and Q33 with their respective associated components could cause the offset. CR19 and CR20 breaking down at an incorrect voltage could cause the offset through the feedback path. Relays K1 and K2 should be energized and deenergized respectively in all ranges except the 100 volt range. In the 100 Volt range, their status should be reversed. Any other configuration could cause an offset and distortion. The output stage components Q20 and Q23, with C12, C17, C19, CR8 and CR9 are also a possible problem. The BIAS CURRENT ADJUST R26 should be set at the minimum but if this reads more than 350 mV, between tp5 (+) and tp4 (−), the circuit is defective. Also check for loading in the output cable.		
44	Repair as required, then repeat step 41.		
45	Remove power from the instrument. Wait at least three minutes, then connect the Power Amplifier Ouput cable to the Attenuator Assembly with a coaxial extension cable and set S1 to the position the red dot is visible. Reconnect the Oscillator Assembly to the Motherboard.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
46	Set the POWER Switch to ON, and after the delay, the MODE switch to STDBY.		
47	While observing the OVERLOAD indicator, rotate the voltage and frequency range switches through their various combinations. Do not exceed the Volt/Hertz specifications.		
48	Did the OVERLOAD indicator come 'ON' for any frequency/voltage range combination?	49	52
49	Were the detailed power supply checks beginning at step 5 performed?	51	50
50	Prepare the equipment as detailed in Step 1, then perform the detailed power supply checks starting at step 5.		
51	Isolate the problem to the Power Amp by removing power, waiting three minutes, then disconnecting it from the Motherboard. If the OVERLOAD indicator remains illuminated, the problem is in the Attenuator, the AC-DC Converter or the Inter-connections. Refer to the applicable tables for these assemblies. Replace the Power Amp. Verify the sense cable between the AC-DC converter and the Attenuator is connected and the Power AMP output cable is connected to the Attenuator since these can cause an overload of the output and driver stages. Disconnect the Oscillator Assembly and the Power Amp output cable. Check the output bias circuit. Check at tp OUTPUT for an oscillation with the input shorted (tp 6 to extender pin 69). If the oscillation is approximately 3 mHz, check U1 and its associated circuitry. If approximately 10 MHz check C43 and C36. If the oscillation is at 250 - 600 MHz it might be Q4 or Q34 through Q37. (These can be traced with a pick up loop and spectrum analyzer display.) Check K1 and K2 in the feedback loop and CR19/CR20. With the overload ($\overline{\text{LIMIT}}$ high) Q39 conducts gating on Q38 to shunt U1 with C8 to stabilize the amplifier and prevent oscillation in U1. Also Q33 will conduct to short the input to input low through C28 for stabilization and quick recovery from the overload. Repair as required then repeat step 47.		
52	Select an output of 1 volt on the 10-volt range at 1 KHz and set the MODE switch to STDBY.		
53	Using an oscilloscope, is an AC signal present at tp OUTPUT, equal to approximately 1 volts rms?	66	54
54	Is an input signal present from the oscillator assembly at extender pin 69?	56	55
55	Check the Oscillator Assembly output, for loading of the output on the Oscillator Control Assembly and the interconnections. Repair as required, then repeat from step 52.		
56	Perform the applicable step from the sequence in steps 57 through 65 to isolate the fault. Repair as required, then repeat the sequence starting at step 52.		
57	The sense loops can be isolated with the following procedure: Verify the Power Amp is on an extender and the Output Cable is not connected to the Attenuator. Disconnect the attenuator sense cable from the AC-DC converter. Short tp4 and tp5 on the AC-DC Converter. Set the MODE switch to operate. In the 10-volt range, the normal indication is a X3 gain between the input from the oscillator and tp OUTPUT. In the 100 Volt range, the gain should be 30. When the Attenuator Feedback loop is disconnected the gain is dependent on the Power Amp feedback resistors R1, R2 and their associated circuitry.		
58	All inputs can be isolated by removing the oscillator and oscillator control assemblies, after power has been removed, and connecting an external oscillator between extender pin 69 (HI) and tp6 (LO). Check for the proper gain (3 or 30 up to the maximum swing) with a scope. The input should be kept below 3.3V rms.		
59	DC levels may be checked by removing the oscillator and oscillator control assemblies, the attenuator sense cable, the Power Amp output cable and shorting the power amp input (extender tp69) to input LO (tp6). Typical DC levels are found in the detailed power supply checks in steps 1 and 5 through 44 which should be performed at this time if not done previously.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
60	Check the DC through Low frequency operation of the Power Amp Assembly. Remove power from the instrument. Wait at least three minutes then remove Q15 and Q9 from the Power Amplifier. Set S1 to the low voltage position (white dot showing), disconnect the Power Amp output cable from the attenuator and short the assembly input (tp6 to extender pin 69). Disconnect the Oscillator and Oscillator Control assemblies from the instrument. Place an alligator clip on one end of 100 ohm 2 watt carbon resistor and a transistor lead on the other. Connect the resistor between the vertical shield in the center of the board and the collector hole of the removed Q15. Turn R26 BIAS CURRENT ADJUST Fully counterclockwise and connect a voltmeter between tp OUTPUT (HI) and tp6.		
61	Select a 1 volt output on the 10 volt range at 1 kHz and set the MODE switch to STDBY. The output should be approximately +2.4V dc. Also check between the top of R72 (HI) and tp6 for approximately −14V dc.		
62	Very carefully remove the load (resistor connected in step 60) and check that the output voltage goes to approximately +22V dc and the voltage at the top of R72 remains at −14V dc.		
63	Connect the 100 ohm resistor between the collector pin on the socket for Q15 and extender pin 77 (−30V). The output voltage should go to approximately −12.5V and the voltage at the top of R72 to approximately −28.5V dc.		
64	The voltage swing at R72 is an indication of the condition of the input and mid stages. The swing of the output is an indication of the condition of the driver and output stages.		
65	Remove power from the instrument. Wait at least three minutes, then replace Q9 and Q15, the disconnected assemblies, and return S1 to the High Voltage Mode of Operation (the red dot visible). R26 is readjusted for the correct bias in the next sequence. Restore power to the instrument.		
66	With a Line isolated voltmeter measure the output stage between tp5 (HI) and tp4. If the voltmeter has a guard connect it to input LO.		
67	Is the bias voltage adjustable by R26 BIAS CURRENT ADJUST to 350 ±10 mV, representing a bias current of 35 mA?	70	68
68	Biasing current for the driver stage is established by CR17. 14 mA flows from the +300V through R82 - R84, CR17, Q14, R28, Q15, Q36, Q37, and Q42 and their associated components to the −190 regulated supply. R26 develops the voltage drop needed across Q14 and R28 to bias the drivers and output transistors. The voltage drop across Q14 should be between 2.24 and 2.84 volts, depending on the setting of R16. The circuit can be affected if C12, CR5 or CR6 are shorted or leaking. CR8 and CR9 can effect the output giving the impression of a bias defect.		
69	Repair as required then repeat step 66.		
70	Verify all assemblies are installed in the instrument (the Power Amplifier on the extender assembly). Switch S1 should have the red dot visible for the High Voltage Mode. Verify the Power Amp output cable is connected to the Attenuator and the Attenuator sense cable connected to the AC-DC converter assembly. *NOTE* *This test insures proper operation and fast recovery to the overload circuit. To perform it the Attenuator Assembly A6 must be operational with its feedback circuit.*		
71	Connect an oscilloscope across the 5200A output terminals.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
72	Obtain an output of 10 volts on the 10 volt range at 1 kHz.		
73	Place a two watt carbon composition 100 ohm load on the output.		
74	Does the OVERLOAD indicator illuminate and the oscilloscope display an attenuated waveform, clipped on both the positive and negative peaks?	76	75
75	Check the −190 regulator if the negative portion is defective, the +190, if the positive, then repeat step 72.		
76	Return to STDBY, verify the OVERLOAD indicator extinguishes. Remove the 100 ohm resistor.		
77	Obtain an output of 100 Volts on the 100-volt range at 1 kHz then apply a 1K ohm 10 watt resistor as a load.		
78	Does the OVERLOAD indicator illuminate and the oscilloscope display an attenuated waveform, clipped on both the positive and negative peaks?	80	79
79	Check the −190 regulator, if the negative portion is defective. The +190, if the positive. Repair as required then repeat step 76.		
80	Return to STDBY and remove the load.		
81	Obtain an output of 10 volts on the 10 volt range at 1 kHz then apply a shorting link to the output terminals.		
82	The OVERLOAD indicator illuminates and the output drops to zero.		
83	Remove the short. The OVERLOAD indicator extinguishes and the output returns to normal.		
84	Is the short circuit recovery feature operational?	86	85
85	Check the −190 regulator, if the negative portion is defective. The +190 if the positive. Repair as required then repeat step 80.		
86	Connect the DC coupled oscilloscope between tp2 (−190V LIM) and tp6 (LO) and obtain a 10 volt (10 Volt range) output at 1 kHz (1 kHz range).		
87	When a short is applied to the 5200A output, does the display fold to zero volts at a 1 kHz rate?	89	88
88	Check Q19, Q24 and their associated components. Repair as required, then repeat step 86.		
89	Connect the AC coupled oscilloscope between tp1 (−190V) and tp6 (LO) and obtain a 10 volt (10 volt range) output at 1 kHz (1 kHz range).		
90	When a short is applied to the 5200A output, does the display peak at +5 and −3 volts at a 1 kHz rate, but not fold back (i.e. go toward zero)?	92	91
91	Check Q31, Q32, Q40 and their associated components. Repair as required, then repeat step 89.		
92	Connect the AC coupled oscilloscope between tp3 (+190V) and tp6 (LO) and obtain a 10 volt (10 volt range) output at 1kHz (1kHz range).		
93	When a short is applied to the 5200A output, does the display fold to zero volts at 1 kHz?	95	94
94	Check the +190V Regulator. Repair as required, then repeat step 92.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
95	Prepare the scope display for AC coupling, 1V/CM, 0.5 ms/CM, then connect it between the negative end of C35 and tp6 (LO).		
96	Short the output terminals, then select a 10 volt on the 10 volt range/1 kHz output.		
97	Does the scope display a waveform of approximately 3 volts peak-to-peak at the negative end of C35?	99	98
98	Check transistors Q41, Q42 and their associated components. If the waveform is 1 volt peak-to-peak replace the transistors. When complete remove the short, repair as required and repeat step 86.		
99	Perform the distortion tests outlined in paragraph 4-43.		
100	Were the results acceptable at all frequencies?	110	101
101	Perform the applicable steps from the sequence in steps 102 through 109 to isolate the fault. Repair as required, then repeat the test starting at step 99.		
102	Disconnect the Power Amp from the extender assembly, short tp4 to tp5 on the AC-DC converter, and check for distortion at extender pin 69. If the distortion remains, check the Oscillator Assembly using the applicable table. Also check the Power Supply for excessive ripple.		
103	If there was no distortion with the Power Amp disconnected, replace the Power Amp, except leave the output cable disconnected, connect a short between tp4 and tp5 on the AC-DC Converter, connect a clip lead between tp7 on the Oscillator and the positive end of C35 (bottom) of the Power Amp and set the Front Panel voltage output switches for 3.3 volts. Check at the positive end of C35 (bottom) for distortion. If distortion remains check for a dc offset or ripple on the outputs of the Power Amp (step 3) and Oscillator Assembly and for failure of C29 or CR29 on the Power Amp input circuit. If the distortion disappears, check for a failure in the Power Amp output stage.		
104	Check the output high and low signal paths back through the sense lines. This can be accomplished by disconnecting the oscillator assembly and applying an external oscillation between 0.3 and 3.3 V rms to the positive (bottom) end of C29 on the Power Amp. With an oscilloscope common on tp2 of the AC-DC Assembly, trace the 0.1 to 1.2 V rms signal back starting at C22 of the AC-DC Converter through the contacts of J52 to the Attenuator Assembly. Refer to Table 4-11 for the Attenuator checks.		
105	Verify the bias as monitored between tp5 (HI) and tp4 (LO) on the Power Amplifier is +350 ±10 mV. Adjust R26 BIAS CURRENT ADJUST for this reading if required. If not adjustable, refer to step 66.		
106	Verify the proper operation of Power Amp relays K1 and K2. In all ranges except 100 volts K1 should be energized and K2 de-energized. In the 100 volt range, the conditions are reversed.		
107	Shorted or leaking zener diodes CR19 and CR20 may cause distortion problems.		
108	Q20 and Q23 may cause breaking down at the high voltage peaks. This can be observed with an oscilloscope by connecting a X10 probe between the bias test points tp4 and tp5. Select and monitor an output of 119V rms at 10 Hz (to obtain the longest possible duty cycle) then slowly increase R26 BIAS CURRENT ADJUST for a bias reading of 450 mV. For clipping on the positive peaks, check Q23 as the most likely problem, for clipping on the negative, check Q20. When completed, reset the bias for 350 ±10 mV.		
109	If the distortion is in the form of an oscillation, repeat the check listed in step 51.		

Table 4-12. POWER AMPLIFIER ASSEMBLY, A7 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
110	Check the gain of the Power Amp by comparing the input signal at the positive end of C35 (bottom) with the signal at tp OUTPUT using an oscilloscope. With the MODE switch in STDBY, the gain should be X3 in all ranges. If the switch is in OPER, the gain should be X30 in the 100 volt range and X3 in all others.		
111	Is the gain correct in all ranges?	113	112
112	Check the operation of relays K1 and K2. In the 100 volt range K2 should be energized and K1 de-energized. In all other ranges, the opposite is true. Resistors R1 and R2 in the feedback path determine the amount of gain. The Power Amp may be operated independently to isolate the gain problems by disconnecting the oscillator and oscillator control assemblies and connecting an external oscillator between the positive end of a C35 (bottom) and tp 6. Repair as required, then repeat from step 110.		
113	The test of the Power Amplifier Assembly A7 is now complete. If any component was replaced or an adjustment changed, a calibration procedure should be performed.		

Table 4-13. AC-DC CONVERTER PCB ASSEMBLY A8

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Remove power from the instrument. Wait at least three minutes, then disconnect the power Amplifier Assembly A7, the Oscillator Control Assembly A9 and the Oscillator Assembly A10 from the Motherboard Assembly A2. Install the AC-DC Converter Assembly A8 in the instrument on the extender pcb assembly. When test points are not available, locations will be defined in reference to a component as it is seen facing the component side of the pcb, i.e., top of R1, bottom of R2, leftside of C3 or right side of K4. Refer to the component location drawings in Section 8 to locate the called out component on the assembly. With jumpers connect extender pin 86 to tp5 and tp2 on A8. Reapply power to the instrument.		
2	Check the floating inside the guard voltages supplied to the A8 Assembly. Connect the DVM LO input to extender pin 54 to check the +15 (F), −15 (F) and +20 (F) input voltages.		
3	Connect the DVM HI input to extender pin 67.		
4	Is the DVM reading between +14.9 and +15.1 volts dc?	5	27
5	Apply a 270 ohm load to the +15 (F) volts input. NOTE *The load may be applied across the DVM input terminals, provided low-ohm test leads are used.*		
6	Does the DVM display change less than 1 volt when the load is applied?	7	27
7	Remove the lead and transfer the DVM HI input to extender pin 61.		
8	Is the DVM reading between −14.5 and −15.5 volts dc?	9	27
9	Apply a 270 ohm load to the −15 (F) volt input.		
10	Does the DVM display change less than 1 volt when the load is applied?	11	27
11	Remove the load and transfer the DVM HI input to extender pin 65.		
12	Is the DVM reading between +19.75 and +20.25 volts dc?	13	27
13	Apply a 270 ohm load to the +20 (F) volt input.		
14	Does the DVM display change less than 1 volt when the load is applied?	15	27
15	Remove the load and transfer the DVM LO input to extender pin 85 to check the standard inside the guard voltages. Transfer the DVM HI input to extender pin 84.		
16	Is the DVM reading between +4.75 and 5.25 volts dc?	17	27
17	Apply a 100 ohm load to the +5 volt input.		
18	Does the DVM display change less than 0.5 volts when the load is applied?	19	27
19	Remove the load and transfer the DVM HI input to extender pin 79.		
20	Is the DVM reading between +14.5 and +15.5 volts dc?	21	27
21	Apply a 270 ohm load to the +15 volt input.		

Table 4-13. AC-DC CONVERTER PCB ASSEMBLY A8 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
22	Does the DVM display change less than 1 volt when the load is applied?	23	27
23	Remove the load and transfer the DVM HI input to extender pin 77.		
24	Is the DVM reading between −14 and −16 volts dc?	25	27
25	Apply a 270 ohm load to the −15 volt input.		
26	Does the DVM display change less than 1 volt when the load is applied?	31	27
27	Isolate the trouble from the Power Supply by removing power from the instrument, remove the A8 assembly from the extender, individually jumper extender pin 86 to extender pins 42, 54 and 72, reapply power and, repeat steps 2 through 26, disregarding the transfer instructions.		
28	Are all the voltages within tolerance?	30	29
29	Check the Power supplies for proper output. The voltages are also used on the Reference Assembly the Switch matrix A3 and the Attenuator A6. Repair or replace as required, then return to the step originating the transfer.		
30	Remove power, remove the jumpers installed in step 27, verify the jumpers installed in step 1 are installed, replace the A8 assembly in the extender assembly, reapply power and check the applicable circuits utilizing the voltage out of tolerance. Repair or replace components as required, then return to the step originating the transfer instruction.		
31	Remove power from the instrument. Open the line from the Reference Assembly at J51 and insert a "T" connector made from a BNC connector and two BNC to conhex adapters between the cable and J51.		
32	Verify the 5200A is set to operate at 1 volt on the 1-volt range and 1 kHz on the 1 kHz range.		
33	Connect the DVM to the "T" connector to monitor the Reference Assembly input and reapply power to the instrument. After the delay, set the MODE switch to STDBY.		
34	Divide the reading displayed on the DVM by ten. Record the result. *NOTE* *The display should be a figure somewhere between 5 and 6 volts. The exact figure is not important, since it will vary, only the fact that the switch settings dividing the figure are linear.*		
35	Set the 5200A to operate at 0.1 volt on the 1-volt range. The DVM should display the figure recorded in step 34 ±0.02%.		
36	Set the 5200A to operate at 0.2 volts on the 1-volt range. The DVM should display the figure recorded in step 34 ±0.02% multiplied by two.		
37	Repeat for each setting of the MSD magnitude switch, multiplying the figure in step 34 by the absolute switch to obtain the desired reading with a tolerance ±0.02%.		
38	Are the readings linear and within tolerance?	43	39
39	Disconnect P51 from the A8 assembly, leaving the "T" connector attached to the cable. Connect the shield of the cable and the shield on the board. Repeat steps 32 through 37 without the load of the A8 assembly on the Reference Assembly.		

Table 4-13. AC-DC CONVERTER PCB ASSEMBLY A8 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
40	Are the readings linear and within tolerance?	42	41
41	Perform the Reference Assembly test in Table 4-16. When the Reference Assembly output is correct, restart the test at step 32.		
42	Check the DC Reference input circuits of the AC-DC Converter Assembly A8 at J51 for loading. When the loading is removed, repeat the test beginning at step 32.		
43	Remove power from the instrument, disconnect the "T" adaptor and reconnect J51 to the A8 Assembly.		
44	Connect extender pins 18 and 86 with a jumper clip lead to energize K4 when power is applied. Verify the two jumpers installed in step 1 are in place.		
45	Apply a 1 volt rms ±0.1% signal at approximately 1 kHz from an external source to J52.		
46	Reapply power to the instrument.		
47	Using an AC differential voltmeter, is the input voltage present at the top of C22?	49	48
48	Check the input circuitry, especially K4. Repair and repeat step 47.		
49	Using an AC Differential voltmeter, is the output of the Buffer amplifier equal to the input voltage (unity gain)?	51	50
50	Measure the typical voltage figures given in Table 4-25 with differential voltmeters to isolate the failure to an individual circuit or component in the buffer amplifier. Repair as required, then repeat step 49.		
51	Repeat step 47, 48, and 49 with the input frequency set at 10 Hz and 1 MHz to check the bandwidth of the Buffer		
52	Check at the Anode of CR10 and Cathode of CR11 with an oscilloscope for the waveform displayed on the schematic of the AC-DC Converter Assembly (Figure 8-11).		
53	Are both waveforms present with a peak voltage of 1.4 volts for an input of J52 of 1V rms?	72	54
54	Remove power from the instrument. Remove the covers from the two DC operational Amplifiers, A8A1 (right) and A8A2 (left) and reverse them. Reapply power to the instrument and recheck the waveforms at the anode of CR10 and Cathode of CR11.		
55	Are both waveforms present with a peak voltage of 1.4 volts?	56	57
56	Remove and replace the defective Amplifier. These amplifiers are not repairable in the field, and must be replaced as a unit. Order Fluke Stock Number 332627. When the defective amplifier has been replaced, repeat step 52.		
57	Restore the DC Operational Amplifiers to their original positions.		
58	Reduce the input voltage at J52 to 0.1 volts rms at 1 kHz.		
59	Using a 20K resistor in series with the HI Lead of a DC differential voltmeter, check at the bottom end of R25 (input to rectifier amp).		
60	Is the reading equal to 0 ±10 μ volts dc?	62	61

Table 4-13. AC-DC CONVERTER PCB ASSEMBLY A8 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
61	Adjust R29 RECT. ZERO for the null ± 10 μ volts. If there is insufficient range for adjustment, check the DC operational Amplifier, the adjustment circuitry, and the rectifier amplifier.		
62	Increase the input voltage at J52 to 1.0 volts rms at 1 kHz.		
63	Attach a 20K ohm resistor in series with the probe then check at the top to R15 for a typical value of +1.724V dc.		
64	Check at the bottom of R16 for a typical value of +1.714V dc or approximately 10 mVolts less positive than the voltage measured at R15.		
65	With an oscilloscope check at the top of R18 for a typical 180 mV peak-to-peak signal riding on a +7.29V dc level.		
66	Check at the top of R22 for a typical value of +8.05V dc.		
67	Check at the bottom of R22 for a typical value of +8.18V dc.		
68	Check at the top of R21 for a typical value of −11.45V dc.		
69	Check at the bottom of R23 for a typical value of −12.16V dc.		
70	Check at the junction of the Q14 and Q15 collectors for a typical 3.5 volts peak-to-peak balanced above and below the dc zero line ±100 mVolts.		
71	Replace components in the rectifier amplifier as required and repeat step 52 until a satisfactory output is obtained. If the rectifier output assembly (406959) consisting of Q14, Q15, Q25, CR10, and CR11 are changed, insure the unit is not mounted flush to the pcb but approximately 3/8 of an inch away from the surface of the pcb.		
72	Select a 1 volt output on the 10 volt range and verify it is applied to J52.		
73	Connect dc coupled scope between tp3 and tp5 (LO).		
74	Check for an output at tp3 of approximately +12.5V dc.		
75	Select an 11 volts output on the 10-volt range.		
76	Check for an output at tp3 of approximately −13.5V dc.		
77	Are the voltages correct and swing from one extreme to the other?	79	78
78	Check the DC Operational Amplifier A8A1 (refer to step 54 for procedure) and Q24 with its associated circuitry. Replace or repair as required, then return to step 72.		
79	Connect the DVM to the bottom of R47 to monitor $\overline{\text{AMPTD1}}$. Rotate the voltage magnitude LSD switch through its range. The DVM reading should go from a small negative value on all even numbers to approximately +15 volts for all odd numbers.		
80	Transfer the DVM to the bottom of R50 to monitor $\overline{\text{AMPTD2}}$. Rotate the voltage magnitude LSD switch through its range. The DVM readings should be approximately +15 volts at settings 2, 3, 6, and 7, with a small negative voltage at other settings.		
81	Transfer the DVM to the bottom of R53 to monitor $\overline{\text{AMPTD4}}$. Rotate the voltage magnitude LSD switch through its range. The DVM readings should be approximately +15 volts at settings 4, 5, 6, and 7, with a small negative voltage at other settings.		

Table 4-13. AC-DC CONVERTER PCB ASSEMBLY A8 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
82	Transfer the DVM to the bottom of R56 to monitor $\overline{\text{AMPTD8}}$. Rotate the voltage magnitude LSD switch through its range. The DVM readings should be approximately +15 volts at settings 8 and 9, with a small negative voltage at other settings.		
83	Were the readings correct at all four resistors?	85	84
84	Check at extender pins 21 ($\overline{\text{AMPT1}}$), 23 ($\overline{\text{AMPTD2}}$), 25 ($\overline{\text{AMPTD4}}$) and 27 ($\overline{\text{AMPTD8}}$) for the correct inputs as outlined in steps 79 through 82. Data present replaces the +15 volts with −5 volts and a slightly positive output replaces the slightly negative voltage for data not present. If any readings are incorrect, check the output from the switch matrix and the interconnecting circuits. If all inputs are correct, check the FETS and Driver Transistors associated with the defective circuit. Repair as required and repeat step 79.		
85	Verify that only the A7, A9 and A10 Assemblies are removed from the circuit, tp2 is connected to tp5, extender pin 86 is connected with a jumper to both extender pin 18 and tp5, and an external oscillator is input to the pcb at J52. Connect an oscilloscope between tp3 (HI) and tp5.		
86	Set the 5200A frequency range to 1 kHz, then apply a 1.2V rms input at 2 kHz from the external source		
87	Does the oscilloscope display of the output at tp3 have a ripple voltage less than 20 mVolts peak-to peak?	88	90
88	Sweep the external oscillator from 100 Hz to 1.2 MHz.		
89	Does the ripple voltage remain less than 20 mV peak-to-peak throughout the entire range?	91	90
90	Check the filter consisting of U2 and its associated circuitry, then repeat step 86.		
91	Set the 5200A frequency range to 100 Hz, then sweep the external oscillator from 10 Hz to 120 Hz.		
92	Does the ripple voltage remain less than 20 mV peak-to-peak through the entire range?	94	93
93	Check that extender pin 59 goes LO in the 100 Hz range only to energize K1. Check the contacts of K1 for closing and C25. Repair as required and repeat step 91.		
94	Transfer the external oscillator input to extender pin 70 (HI) and tp5 (LO). Remove the jumper from between extender pins 18 and 86 and connect it between tp4 and tp5. (The OVERLOAD indicator comes on automaticlly when these two points are jumpered).		
95	Set the external oscillator output for 3V rms $\pm$0.1% at 1 kHz.		
96	Is the input signal present at the top of C22 (approximately 1V rms)?	98	97
97	Check relay K3 and its contacts. Repair as required and repeat step 95.		
98	Test of the AC-DC Converter A8 is complete. If any component was replaced or an adjustment changed a calibration procedure should be performed.		

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Remove power from the instrument. Wait at least three minutes, then install the Oscillator Control Assembly, A9 on an extender pcb. Leave the three coaxial cables connecting the assembly to the rear panel disconnected. Verify all assemblies except the Power Amplifier A7 are installed in the instrument. When test points are not available, locations will be defined in reference to a component as it is seen facing the component side of the pcb, i.e., top of R1, bottom of R2, left side of C3 or right side of K4. Refer to the component location drawings in Section 8 to locate the called out component on the assembly. Connect a jumper between tp4 and tp5 on the AC-DC Converter Assembly A8.		
2	Set the POWER Switch to ON, the CONTROL Switch to LOCAL, the PHASE LOCK Switch to OFF, the SENSE Switch to INT, Select 1 volt on the 10-volt range and 1 kHz on the 1 kHz range. If the OVERLOAD indicator stays on more than 5 seconds, refer to table 4-9, step 7.		
3	Connect the DVM LO input to extender pin 85. Use this point as common while checking the input voltages to the assembly.		
4	Connect the DVM HI input to extender pin 75 and check for a reading between +29 and +31 volts dc.		
5	Transfer the DVM HI input to extender pin 73 and check for a reading between −29 and −31V dc.		
6	Transfer the DVM HI input to extender pin 79 and check for a reading between +14.5 and +15.5V dc.		
7	Transfer the DVM HI input to extender pin 77 and check for a reading between −14 and −16V dc.		
8	Transfer the DVM HI input to extender pin 84 and check for a reading between +4.75 and +5.25V dc.		
9	Are all the voltages present and within tolerances?	11	10
10	Check the outputs from the Power Supply Assembly and their interconnections, then repeat the checks beginning at step 3.		
11	Repeat steps 3 through 7 while applying a 270 ohms load. The change in voltage should be less than 1 V dc for all steps. If Low-Ohm test leads are used the load may be applied across the DVM input terminals.		
12	Repeat step 8 while applying a 100 ohm load. The change in voltage should be less than 0.5 volts dc.		
13	Do the input voltages stay within tolerance?	19	14
14	Remove power, wait at least three minutes, then remove the oscillator control assembly from the extender board and reapply power. After the dealy, se thte MODE swtich to STDBY.		
15	Repeat steps 3 through 8, 11 and 12 with the Oscillator Control Assembly rem		
16	Are all voltages within tolerance?	17	18
17	Check the output from the Power Supply using the applicable table and the interconnection circuits. Repair as required, then repeat the check beginning at step 1.		
18	Check the circuits on the pcb using the voltage or voltages which are out of tolerance. When the loading circuit is identified, repair as required, then repeat the check beginning at step 1.		
19	Transfer the DVM HI input to U10 pin 4 and check for a reading between +14.5 and +15.5V dc.		
20	Transfer the DVM HI input to U10 pin 11 and check for a reading between −14.5 and −15.5 V dc.		

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
21	Transfer the DVM HI input to the anode of CR3 (bottom) and check for a reading between +11 and +13 Volts dc.		
22	Transfer the DVM HI input to the Anode of CR4 (bottom) and check for a reading between −5 and −7 volts dc.		
23	Are all the voltages present and within tolerance?	25	24
24	Check the applicable regulator circuit, repair as required, and repeat steps 19 through 23.		
25	Repeat steps 19, 20 and 21 while applying a 1.8 k ohm load. The change in voltage should be less than 0.5V dc for all steps.		
26	Repeat step 22 while applying a 470 ohm load. The change in voltage should be less then 0.5 Volts.		
27	Do the voltages stay within tolerance?	29	28
28	Check the circuits on the assembly using the affected voltages. Repair as required and repeat the check beginning at step 19.		
29	Check the output of the oscillator assembly A10 between tp 7 (HI) and tp 1 with an oscilloscope.		
30	Is an oscillation present?	63	31
31	To continue with this check, it is assumed that the AC-DC Converter Assembly A8, and the Oscillator Assembly A10 are operational. If this assumption has not been verified, check the two assemblies using their respective test procedures.		
32	Use tp 1 as common.		
33	Check the Zero Crossing Detector circuit by connecting an external 0.5V rms, 1 kHz sine wave to the junction of R4/R5/U1-3 (bottom of either resistor) through a 0.1 μF capacitor.		
34	Is the output a square wave, approximately 3 volts peak-to-peak, and 180° out of phase with the input?	37	35
35	Check U1 and its associated circuitry and repair as required.		
36	Is an oscillation now present at tp 7 (HI) and tp 1 of the Oscillator Assembly A10?	63	33
37	Check the On-shot multivibrator circuits by monitoring with a scope the signal at tp 3 (base of Q10). Apply an external 0.5V rms sine wave at 1 kHz to the Zero Crossing defector to the junction of R4/R5/U1-3 (bottom of either resistor through a 0.1 μF capacitor).		
	NOTE *If the pulses are difficult to see at the higher frequency settings, the input frequency may be increased to increase the repetition rate.*		
38	Select the 1 MHz range and check for an 0.1 μsec pulse width at tp3.		
39	Select the 100 kHz range and check for an 0.5 μsec pulse width at tp3.		
40	Select the 10 kHz range and check for a 5 μsec pulse width at tp3.		
41	Select the 1 kHz range and check for a 50 μsec pulse width at tp3.		

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
42	Select the 100 Hz range and check for a 380 μsec pulse width at tp3.		
43	Are all waveforms present and correct?	46	44
44	If all the 100 kHz or the 1 mHz pulses are incorrect or missing, check U2 and its associated circuitry. Check the U15 circuit if the 10 kHz or 1 kHz pulses are incorrect. Check the U11 circuit if the 100 Hz pulse is incorrect. Repair as required.		
45	Is an oscillation now present between tp 7 (HI) and tp 1 of the Oscillator Assembly, A10?	63	37
46	Check the Switch Driver Circuits with the same 0.5V rms 1 kHz signal input at the zero Crossing detector. A chopped scope display of the waveforms at the collectors of Q11 and Q12 should be approximately 1.2 volts peak-to-peak centered on a zero Vdc reference with the two square waves opposite in polarity or 180° out of phase.		
47	Are both signals present and correct?	51	48
48	Check the transistors in the switch driver circuit and their associated components. Check the diodes CR9 through CR14 that are driven by the circuit' Repair as required.		
50	Is an oscillation now present between tp 7 (HI) and tp 1 of the Oscillator Assembly (A10)?	63	46
51	Check the input to the DC Amp at tp 7 (tp 1 common).		
52	Is the reading some DC value, typically between −1 and −12V dc, but less than the AC-DC Converters limit voltage of approximately −15V dc? (Reading should be the same as tp3, AC-DC Converter.)	55	53
53	Since the assumption was made that the AC-DC Converter, A8 is operational, check the interconnections between the two assemblies. If there is any question on the operational state of the A8 assembly perform the test in the applicable table.		
54	Is the oscillation now present between tp 7 (HI) and tp 1 of the Oscillator Assembly A10?	63	51
55	Check the dc voltage levels in the DC Amp, Diode Switches and Integrator circuits using Table 4-26. Verify the instrument is in the configuration described in steps 2 and 3 prior to beginning the check. After completing the table with the Oscillator Assembly A10 installed, remove power, remove A10, reapply power and complete the table. All values given in the table are typical and will vary slightly between instruments.		
56	Are all values in the table correct?	59	57
57	Check the circuits indicated by the test in the table. In the DC Amp FETS Q1 and Q17 are a matched pair selected at the factory. Order with Fluke Part Number 337774 with the red dot installed in Q1 and the yellow dot in Q17. To test the circuit connect an isolated High Input Impedance DVM between tp 7 (HI) and the junction of R2/R103 (bottom of both). The DVM should read approximately −0.5V dc. If it reads some positive voltage, replace the Q1/Q17 combination. If the Integrator balance is incorrect at tp 6, check by removing A10, placing a 1K resistor between tp 5 and tp 6 on the Oscillator Control Assembly and then monitorying tp 6 (tp 1 - LO) for 0 ±0.5V dc. Then vary R110 to its limits to insure the signal swings from approximately +1.25 V dc to −1.25V dc, bringing tp 6 to zero at some point in the adjustment. If it will not balance, check the matched set Q5/Q6 and/or the FETS Q4, Q29, Q30, Q31. This check of R110 is a troubleshooting adjustment only. When completed, R110 should be recalibrated. Repair the circuits as required.		

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
58	Is an oscillation now present between tp 7 (HI) and tp 1 on the Oscillator Assembly A10?	63	55
59	Check the voltage levels in the Four Quadrant Multiplier and Hi Freq. Rolloff Compensator circuits using the values in the Table 4-27. Verify the instrument is in the configuration described in steps 2 and 3 prior to beginning the check. After completing the table with the Oscillator assembly, A10 installed, remove power, remove A10, reapply power and complete the table. All values given in the table are typical and will vary slightly between instruments.		
60	Are all values in the table correct?	63	61
61	Check the circuit indicated by the tests in the table. The Four Quadrant Multiplier U3, may be isolated by exchanging it with the identical IC used at U9. The HI Freq. Rolloff Compensator provides again only at the highest frequencies. Refer to the calibration procedure for the steps required to adjust C54. Replacement of any frequency determining components on the Oscillator or Oscillator control assemblies may require a change in the capacity padding of C55. If required, use a high quality mica type capacitor. Repair the circuits as required.		
62	Is an oscillation now present between tp 7 (HI) and tp 1 on the Oscillator Assembly A10?	63	59
63	Connect a frequency counter between tp 7 (HI) and tp 1 on the Oscillator Assembly A10.		
64	Select 100 Hz on the 100 Hz range and check for an output between 99 and 101 Hz.		
65	Select 1 kHz on the 1 kHz range and check for an output between .99 kHz and 1.01 kHz.		
66	Select 10 kHz on the 10 kHz range and check for an output between 9.9 kHz and 10.1 kHz.		
67	Were all three frequencies within one percent?	69	68
68	The oscillator Control Assembly has control over range selection in the 100 Hz, 1 kHz and 10 kHz ranges. If the frequency has a large variation, check the appropriate relay. (K1, K2 and K3 respectively). and their associated circuits. Test points and typical voltage readings are given in Table 4-28. If the frequency error is minimal, the Oscillator Assembly should be checked first using the applicable table since that is more likely to be the source of the problem.		
69	Connect a RMS voltmeter between tp 7 (HI) and tp 1 (LO) on the oscillator assembly. Select the 100 Hz frequency range.		
70	Vary the voltage amplitude MSD from 0.1 to 1.0 (10 Hz to 100 Hz) while checking for a linear change from 0.33V rms to 3.3V rms (approximately).		
71	Select in turn, the other four frequency ranges and check for the linear voltage change.		
72	Is the oscillator voltage output linear on all five frequency ranges?	74	73
73	Check the DC Amp, Diode Switches and Integrator using the test points and typical values in Table 4-26. Check the 4 Quadrant Multiplier and Hi-Freq. Rolloff Compensator using the test points and typical values in Table 4-27. In addition, if not all ranges are defective, check the switching FETS Q20 through Q23 and their associated feedback capacitors. If only the 1·mHz range is non-linear, remove the pcb from the extender and install it directly in the instrument and recheck before troubleshooting since operation on the extender might effect the Hi-Freq. Rolloff Compensator circuit. Repair as required and then repeat the check beginning at step 69.		
74	Connect an oscilloscope to the J66 COUNTER output on the rear of the 5200A. If the Oscillator Control Assy is on an extender connect the oscilloscope to J62 on the assembly.		

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
75	Check for an 0.1μsec pulse with the 100 Hz, 1 kHz and 1 MHz ranges selected		
76	Check for a 0.5 μsec pulse with the 100 kHz range selected.		
77	Check for a 5 μsec pulse with the 10 kHz range selected.		
78	Is the pulse present with the correct width and an amplitude of at least 3 volts peak-to-peak in all five frequency ranges?	80	79
79	Check U13 and its associated circuitry, repair as required and repeat the check beginning at step 74.		
80	Using a short lead, connect the J65 Rear Panel Quadrature Output to a RMS differential voltmeter. If the Oscillator Control Assy is on an extender connect the differential voltmeter to J63 on the assembly.		
81	Vary the voltage amplitude MSD from 0.1 to 1.1 checking the linearity and amplifude of the output.		
82	Is the output voltage and linearity within the published specifications?	84	83
83	Check U14 and its associated circuitry, check zeners CR40 and CR41 whick develop operating voltages for U14 and check the cabling for loading. Repair as required and then repeat the check beginning at step 80		
84	Remove power, install all assemblies in the instrument, install the top cover, and shield, reapply power and perform the PHASE LOCK test in paragraph 4-52.		
85	Is the Phase Lock Test satisfactory?	104	86
86	Remove power, the top cover and shield, wait at least 3 minutes then install the A9 Assembly on an extender pcb assembly and reapply power.		
87	Verify that extender pin 44 is at Logic LOW to enable the Squaring amplifier. It should be LOW except when the 1000V range is selected.		
88	Check the squaring amplifier by applying either the oscillator output from tp7 on the Oscillator assembly or an input of approximately 1V rms from an external oscillator to the junction of U7/R69/R70 through a 0.1 μF coupling capacitor and clip leads.		
89	Is the output at tp 2 a square wave at approximately 4 volts peak-to-peak, at the selected frequency?	91	90
90	Check the squaring amplifier and repair as required. Note that the operating voltages for U7 are established by CR34 and CR45. Repeat the test starting at 88.		
91	To check the Phase Detector and Amplifier circuits, apply a variable external oscillation of approximately 1 volt rms to the junction of U7/R69/R70 through an 0.1 μF coupling capacitor.		
92	Connect a dc coupled oscilloscope to U8-2.		
93	Set the external frequency slightly higher than the Front Panel selected frequency and check with the scope for approximately +1 volt dc with some beat frequency.		
94	Change the external frequency to slightly less than the Front Panel selected frequency and check for approximately −1V dc with some beat frequency.		
95	Match the external and selected frequencies and check for zero volts and no beat frequency.		
96	Is the output correct at all three frequencies?	98	97

Table 4-14. OSCILLATOR CONTROL ASSEMBLY A9 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
97	Check the Phase Detector and its associated circuitry. Repair as required and repeat the test beginning at step 91.		
98	Transfer the oscilloscope input to tp4.		
99	Repeat steps 93, 94 and 95 replacing +1V dc in step 93 with +13V dc and −1V dc in step 94 with −13V dc.		
100	Repeat step 99 with each of the other four frequency ranges.		
101	Is the output correct at all frequency ranges?	103	102
102	If defective in all ranges, check U8 and its associated components. If defective in one or more ranges, check the FETS, the feedback components and the logic lines. Repair as required and repeat the test beginning at step 98.		
103	If the phase detection signal is present at tp4, but the phase lock circuitry is not operational, check the PHASE LOCK Logic line at extender pin 31, Relay K5, Q32 and Q33, the inputs to U9 and Q24. Isolation of U9 may be accomplished by interchanging U3 and U9, however, if the IC that had been installed in U9 is defective, the problem will transfer to the amplitude channel and signals required to operate the multiplier circuit may be missing. Be sure and replace the two IC's in their original sockets if they are interchanged. Repair as required and then repeat the test starting at step 84.		
104	The test of the Oscillator Control Assembly A9 is now complete. If any component was changed or an adjustment changed, a calibration procedure should be performed.		

Table 4-15. OSCILLATOR PCB ASSEMBLY A10

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Remove power from the instrument. Wait at least three minutes, then disconnect the Power Amplifier Assembly A7, the AC-DC Converter Assembly A8, and the Oscillator Control Assembly A9 from the Motherboard Assembly, A2. Install the Oscillator Assembly A10 in the instrument on the extender pcb Assembly. When test points are not available, locations will be defined in reference to a component as it is seen facing the component side of the pcb., i.e., top of R1, bottom of R2, left side of C3 or right side of K4. Refer to the component location drawings in Section 8 to locate the called out component on the assembly. With three jumpers, connect tp1 to tp2, tp4 and extender pin 86. Also connect tp4 and tp5 on the AC-DC Converter Assembly with a jumper. Very carefully unsolder then remove the bottom end of R1 from the pcb. Reapply power to the instrument. *NOTE* *To provide a return path, Extender pin 86 must be connected to tp1 anytime the Oscillator Control Assembly is not installed in the instrument.*		
2	Connect the DVM LO input to extender pin 85. Use this point as common while checking the input voltages to the assembly.		
3	Connect the DVM HI input to extender pin 80 and check for a reading between +14.5 and +15.5 Volts dc.		
4	Transfer the DVM HI input to pin 78 and check for a reading between −14 and −16 Volts dc.		
5	Transfer the DVM HI input to the land pattern at the top center of the pcb labeled +15 and check for a reading between +14.5 and +15.5 Volts dc.		
6	Transfer the DVM HI input to the −15 land pattern and check for a reading between −14 and −16 Volts dc.		
7	Transfer the DVM HI input to pin 76 and check for a reading between +29 and +31 volts dc.		
8	Transfer the DVM HI input to pin 74 and check for a reading between −29 and −31 Volts dc.		
9	Are all voltages present and within tolerance?	11	10
10	Check the outputs from the Power Supply Assembly and the interconnections, then repeat the checks beginning at step 2.		
11	Repeat steps 2 through 9 while applying a 270 ohm load. The change in voltage should be less than 1 Volt dc for all steps. The load may be applied across the DVM input terminals if Low-Ohm test leads are used.		
12	Do the input voltages stay within tolerance?	18	13
13	Remove power, wait at least three minutes, then remove the A10 assembly from the extender board. Leave the extender installed and jumper pin 57 to pin 86. Reapply power to the instrument.		
14	Repeat steps 2, 3, 4 and 7 through 11 with the A10 assembly removed.		
15	Are the power supplies still loaded?	16	17
16	Check the power supply assembly and interconnections for loading. Repair as required. Remove the jumper between extender pins 57 and 86 and install the Oscillator assembly in the extender. Repeat the check starting at step 2.		

Table 4-15. OSCILLATOR PCB ASSEMBLY A10 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
17	Isolate the component loading the applicable input and repair as required. Remove the jumper between extender pins 57 and 86 and install the Oscillator assembly in the extender. Repeat the check starting at step 2.		
18	Measure and record the voltage between tp3 (HI) and tp1 with a DVM.		
19	Vary R2 from one extreme to the other while observing the DVM display.		
20	Does the DVM vary from approximately +15 to approximately −15 volts dc at the two extremes?	21	59
21	Remove the jumper between tp1 and tp2. Replace the jumper with a 1K ohm resistor, using clip leads. Verify tp1 is jumpered to extender pin 86.		
22	Vary R2 from one extreme to the other while observing the DVM display.		
23	Does the display vary through zero volts dc over a total spread of approximately 13 mV dc?	24	59
24	Begin the check of amplifier A10A2 by verifying tp1 is jumpered to both tp6 and extender pin 86, the jumper between tp1 and tp4 is removed and a 1K ohm resistor on clip leads connects tp1 and tp2. Transfer the DVM HI input to tp5.		
25	Vary R2 from one extreme to the other while observing the DVM display.		
26	Does the DVM vary from approximately +15 to approximately −15 volts dc at the two extremes?	27	59
27	Connect a 1K ohm resistor between tp4 and tp5 with short clip leads.		
28	Vary R2 from one extreme to the other while observing the DVM display.		
29	Does the display vary through zero volts dc over a total spread of approximately 13 mV dc?	30	59
30	Begin the check of Amplifier A10A3 by verifying tp1 is jumpered to extender pin 86. Remove the jumper between tp1 and tp6. Verify a 1K ohm resistor connects tp1 and tp2 and another 1K ohm resistor connects tp4 and tp5. Transfer the DVM HI input to tp7.		
31	Vary R2 from one extreme to the other while observing the DVM display. The output may contain about 80mV of high Frequency Oscillation during these steps. To remove this oscillation add a 0.1 μF capacitor on clip leads between tp1 and tp7.		
32	Does the DVM vary from approximately +7.8 to approximately −7.8 Volts dc at the two extremes?	33	59
33	Connect a third 1K ohm resistor between tp6 and tp7 with short clip leads.		
34	Vary R2 from one extreme to the other while observing the display.		
35	Does the display vary through zero volts dc over a total spread of approximately 13 mV dc?	36	59
36	Remove all jumpers and resistors except the jumper connecting tp1 and extender pin 86.		
37	With the DVM connected between tp7 (HI) and tp1 adjust R2 for a reading of 0 $\pm$10 mVdc.		
38	Connect a 2K ohm resistor between tp7 and the disconnected end of R1. Set the Frequency Magnitude MSD switch to 0.1. If the 0.1 uF capacitor was installed in step 31 remove it.		
39	Connect an oscilloscope and a frequency counter between tp7 (HI) and tp1.		

Table 4-15. OSCILLATOR PCB ASSEMBLY A10 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
40	Check for an output of approximately 50 kHz and 14 volts peak-to-peak. (The A9 assembly is not installed at this time so the front panel range switch is inoperative.)		
41	Check the output of each position of the Frequency Magnitude MSD Switch. The frequency should increase approximately 50 to 60 kHz for each switch increment. The voltage should remain fairly constant, decreasing slightly as the frequency increases.		
42	Is the independent operation of the oscillator acceptable?	44	43
43	Check the FET switches, capacitors and interconnections between the stages. Repair as required, then repeat the check starting at step 40.		
44	Remove Power from the instrument. Solder in place the end of R1 previously disconnected. Remove all jumpers. Replace any boards disconnected except the Power Amplifier Assembly A7. On the AC-DC Converter Assembly A8 jumper tp4 and tp5. Set the Frequency Range to 1 kHz. Connect a Frequency counter to the Oscillator Output tp7 (HI) and tp1 (LO). Reapply power to the instrument.		
45	Vary the Frequency Magnitude Switches throughout their range.		
46	Are all frequency settings within the specifications?	52	47
47	If there is no output check the input. It originates at the AC-DC Converter Assembly tp3, is acted upon by the Oscillator Control Assembly A9 and is routed through the Motherboard A2. If there is no oscillation tp3 on the AC-DC Converter will be at approximately −13V dc.		
48	If the frequency is high at all settings, check relays K1 and the frequency range relays on the Oscillator Control Assembly. K2 should be energized from the Oscillator Control Assembly for all frequency ranges except 1 MHz.		
49	If the frequency is high at some but not all magnitude settings, try the switch settings at positions 1, 2, 4 and 8 until the frequency is correct. Check the FET switches and drivers in that channel for components that stay "on", such as leaky FET SWITCHES. Use Table 4-29 to determine the correct switch logic outputs.		
50	If the frequency is low, check at switch positions 1, 2, 4 and 8 of the magnitude levels. Check the channel with the missing or lowest ratio output for open components. Use Table 4-29 to determine the correct switch logic outputs.		
51	Repair as required, then repeat step 45.		
52	Remove power from the instrument. Remove any jumpers and loads installed except the jumper between tp4 and tp5 on the AC-DC Converter. Install internally all assemblies except the Power Amplifier A7 and install the inner guard. Connect a frequency counter to the Counter Output at the rear of the instrument. Reapply power to the instrument.		
53	Monitor the output frequency of various magnitude settings on the 100 Hz and 10 kHz ranges.		
54	Are the output frequencies within specifications?	56	55
55	Check the range controls for the 100 Hz and 10 kHz on the Oscillator Control Assembly A9, then repeat 53.		
56	Monitor the output frequency at various magnitude settings on the 100 kHz and 1 MHz ranges.		
57	Are the output frequencies with specificationsl	74	58

Table 4-15. OSCILLATOR PCB ASSEMBLY A10 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
58	Check the range control circuitry for the 100 kHz and 1 MHz ranges, then repeat step 56.		
59	Verify a shorting jumper is installed between tp1 and tp2. Make the voltage checks in the following procedure using tp1 as common for the DVM input. All voltages given are typical and will vary slightly between instruments. Once a voltage level has been established, for example, by testing A1, the voltage level should be consistant at the same relative point in the remaining amplifiers. Select only the check for the applicable component. Most checks list a component check point for each of the three amplifiers available; A10A1 Summing Amplifier, A10A2 Quadrature Amplifier and A10A3 Oscillator Amplifier. Enclosed in parenthesis behind the component is a convenient location for the test. The test should be performed with the Oscillator assembly on an extender, all other assemblies except the Power Amplifier installed, a jumper between tp4 and tp5 on the AC-DC Converter, 1 kHz on the 1 kHz range selected, the instrument in standby and R2 adjusted so that tp7 reads close to 0 ±10 mV.		
60	Check for 0 ±10 mV dc at the gate of the applicable transistor: A1 - Q50 (top of R4), A2 - Q58 (top of R131), A3 - Q66 (top of R132).		
61	Check for 0 ±0.5V dc at the gate of the applicable transistor: A1 - Q51 (top of R83), A2 - Q59 (top of R110), A - Q67 (top of R134).		
62	Check for +1.13V dc at the junction of the applicable resistors: A1 - R78/R79 (bottom of either), A2 - R106/R107 (bottom of either), A3 - R136/R137 (bottom of either).		
63	Check for +10V dc at the base of the applicable transistor: A1 - Q52, A2 - Q60, A3 - Q68.		
64	Check for −14.5V dc at the base of the applicable transistor: A1 - Q54 (top of R89), A2 - Q62 (top of R116), A3 - Q70 (top of R141).		
65	Check for +0.7V dc at the base of the applicable transistor: A1 - Q56 (top of C13 or bottom of R97), Q2 - Q64 (top of C231 or bottom of R12), A3 - Q72 (top of C34 or bottom of R148).		
66	Check for −0.7V dc at the base of the applicable transistor: A1 - Q57 (bottom of C13 or R99), A2 - Q65 (bottom of C23 or R126), A3 - Q73 (bottom of C34 or R153).		
67	Check for +6.7V dc at the Cathode of the applicable diode: A1 - CR5 (top), A2 - Cr11 (top). A3 - CR17 (top).		
68	Check for −6.7V dc at the anode of the applicable diode: A1 - CR6 (bottom), A2 - CR12 (bottom), A3 - CR18 (bottom).		
69	Check for 0 ±50 mV dc at the anode of CR23 (bottom for A10A3 only.		
70	Check for 0 ±50 mV dc at the cathode of CR25 (top) for A10A3 only.		
71	Check for +6.7V dc at the cathode of CR26 (top) for A10A3 only.		
72	Check for −6.7V dc at the anode of CR27 (bottom) for A10A3 only.		
73	Use any reading not acceptable as a basis for troubleshooting the applicable amplifier. Repair as required then repeat the step originating the transfer.		
74	The test of the Oscillator Assembly A10 is now complete. If any component was replaced or an adjustment changed, a calibration procedure should be performed.		

Table 4-16. REFERENCE ASSEMBLY A12

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
1	Before Performing the Reference Assembly test insure the Power Supply Switchboard and Mother Assemblies are fully operational.		
2	Remove Power from the instrument. Wait at least three minutes, then disconnect the Power Amplifier Assembly A7 from the instrument. Verify the AC-DC Converter and Oscillator Control Assemblies are installed in the instrument with a jumper connecting tp4 and tp5 on the AC-DC Converter. Remove the two shield covers from the Reference Assembly then install it in the instrument on the extender pcb assembly. It will be necessary to temporarily disconnect the Oscillator Control Oscillator and Remote Control Unit Assemblies to free the coaxial cable which normally connects to J51 on the AC-DC Converter. Connect the shield of the coaxial cable to the shield of J51 on the AC-DC Converter using a short clip lead. When test points are not available, locations will be defined in reference to a component as it is seen facing the component side of the pcb, i.e., top of R1, bottom of R2, left side of C3 or right side of K4. Refer to the component location drawings in Section 8 to locate the called out component on the assembly.		
3	Select POWER ON, LOCAL, PHASE LOCK OFF, VOLTAGE ERROR % OFF, 1 Volt on the 1-Volt Range and 1 kHz on the 1 kHz Range on the Front Panel Controls.		
4	With a DVM check between extender pins 81 (HI) and 77 for a reading between +14.5 and +15.5V dc.		
5	Apply a 270 ohm load to the DVM terminals and check for a change in voltage of less than 0.25V dc.		
6	Check between extender pins 79 (HI) and 77 for a reading between −14 and −16V dc.		
7	Apply a 270 ohm load to the DVM terminals and check for a change in voltage of less than 0.5V dc.		
8	Check between extender pins 83 (HI) and 77 for a reading between +19.5 and +20.5V dc.		
9	Apply a 270 ohm load to the DVM terminals and check for a change in voltage of less than 0.5V dc.		
10	Check between extender pins 2 (HI) and 5 for a reading between +14 and +16V dc.		
11	Apply a 270 ohm load to the DVM terminals and check for a change in voltage of less than 0.5V dc.		
12	Check between extender pins 1 (HI) and 5 for a reading between −14 and −16V dc.		
13	Apply a 270 ohm load to the DVM terminals and check for a change in voltage of less than 0.5V dc.		
14	Check between extender pins 8 (HI) and 5 for a reading between +4.5 and +5.5V dc.		
15	Apply a 10 ohm load to the DVM terminals and check for a change in voltage of less than 0.5V dc.		
16	Were all input voltage checks within tolerance?	18	17
17	If an input voltage is not present check the output from the power supplies and the Mother Assembly. For loading failures remove the Reference Assembly from the extender, leaving the extender installed in the instrument, and recheck the effected voltage or voltages. To isolate the loading to the Reference Assembly or the supply circuits. Since the Reference Output is used to generate the +20V (F) supply which is one of the inputs it is necessary to apply an external +6.955V dc between extender pins 60 (+) and 77 (−) and jumper pins 75 and 77 to complete the circuit for the tests. Repair as required then repeat the test starting at step 3.		
18	Connect a differential voltmeter between tp2 (HI) and tp4 on the Reference Assembly.		
19	Adjust R48 for a differential voltmeter reading of +7V dc ±10uV.		

Table 4-16. REFERENCE ASSEMBLY A12 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
20	Is the adjustment attainable?	22	21
21	The +7 Volt reference supplies a reference to the floating +20V which is used to generate the +7 Volts. If the +20 (F) is within tolerance it is possible that values of some components has shifted sufficiently to prevent attaining the adjustment or the circuit is being loaded from within. Check for typical voltages at the points indicated. U29-2, +6.969V dc; U29-3, +6.975V dc; U29-6, +7.65V dc; Q14 Emitter, +7.1V dc; Q14 base, +6.4V dc; Q14 Collector, +6.2V dc; Extender pins 60 and 68, 6.955; Extender pin 64, +3.46V dc. Repair as required then repeat the test starting at step 18.		
22	Leave the voltmeter connected between tp2 (HI) and tp4. Set the VOLTAGE ERROR % switch to X1 and the vernier dial to zero.		
23	Can R75 be adjusted to a differential voltmeter reading of +7V dc ±20 uV?	25	24
24	Check U33 and its associated components. Typical voltage are +3.47V dc at U33-2, +3.46V dc at U33-3 and +6.955V dc at U33-6. Repair as required and repeat the test starting at step 22.		
25	Verify the differential voltmeter is connected between tp2 (HI) and tp4. Set the vernier dial to +3.0 and check for a reading of +6.790V dc ±1mV.		
26	Set the vernier dial to −3.0 and check for a reading of +7.21V dc ±1mV.		
27	Set the VOLTAGE ERROR % switch to X.1 with the vernier dial still at −3.0. Check for a reading of +7.021V dc ±1mV.		
28	Set the vernier dial to +3.0 and check for a reading of +6.979V dc ±1mV.		
29	Were all four readings within their respective tolerances?	31	30
30	Check U33 and its associated circuitry. Also verify the operation of the Voltage Error Switch, dial and relay K1 on the switchboard (Table 4-9 starting at step 46) and check the interconnections on the Mother Assembly. If the readings were incorrect on one scale and not the other (X1 or X.1) check the applicable series resistor R65 or R69.		
31	Set the VOLTAGE ERROR % switch to OFF and the vernier dial to zero. Verify the output cable is disconnected from J51 on the AC-DC converter assembly with the cable and connector shields connected with a clip lead.		
32	With an oscilloscope check the output cable for a ripple voltage on the output dc voltage.		
33	Is the ripple less than 3mV peak-to-peak?	35	34
34	Check the Active filter. Typical values are 3mV dc at U31-2, 0V dc at U31-3, +6mV dc at U31-6, +2mV dc at U32-2, 0V dc at U32-3 and +3mV dc at U32-6. Repair as required then repeat step 32.		
35	Verify the instrument is set to 1 Volt on the 10-Volt range and 1 kHz on the 1 kHz range.		
36	Record the DC Voltage reading on the Output Cable with a DVM.		
37	Select 2 volts on the 10-Volt range and record the dc voltage reading on the output cable.		
38	Subtract the reading recorded in step 36 from the recorded reading in step 37.		
39	Vary the Voltage Magnitude MSD through the remainder of its range.		

Table 4-16. REFERENCE ASSEMBLY A12 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
40	The reading at the output cable should increase by the figure obtained in step 38 ±0.03% for each increasing step in magnitude.		
41	Check the linearity of change for the second, third and fourth MSD. Do not check the LSD at this point.		
42	Are the voltage changes linear for all ranges?	54	43
43	Check the frequency of the 10 MHz clock at tp1.		
44	Is the frequency at tp1 10 MHz ±10 kHz?	46	45
45	Check the clock circuit. Typical dc voltages at various component locations follow. Emitter Q1 and Q2 ≈+8.7V, Base Q1 and Q2 ≈+8.22V, Collector Q1 ≈+2.45V, Collector Q2 ≈+2.27V, Collector Q4 ≈+3.45, Emitter Q3 and Q4 ≈−0.68V, Collector Q3 ≈+6.95, Base Q5 ≈+1.7V and Base Q6 ≈+1.0. Repair as required then repeat step 43.		
46	Using internal triggering, check with a scope for a 0.1 μsec negative start pulse at U18-6 and a 0.1 μsec negative stop pulse at U18-8. The pulses should reoccur at approximately 13 msec intervals and be approximately 4 volts peak-to-peak.		
47	Is the Start pulse present at U18-6?	49	48
48	Check the counter outputs. Repair as required then repeat step 47.		
49	Is the stop pulse present at U18-8?	51	50
50	Check the inputs to the U18-8 NAND gate to isolate the portion of the comparator and/or input gating causing the problem. To test U18-13, trigger the scope at U12-15 and observe while varying the fifth MSD (5th decade from the left). The display should be a 0.1 μsec for each step of the decade switch. Move the scope trigger to U13-15 and vary the fourth MSD and the 0.1 μsec pulse should move 1 μsec to the right for each step of the switch. For the U18-12 input, trigger the scope at U14-15 and observe for a 4 μsec pulse that shifts to the right 10 μsec for each step of the third MSD. Start the test of U18-10 with the trigger at U15-15. Vary the second MSD and observe a 100 μsec pulse shift right 100 μsec for each step. Move the trigger to U16-1 and the 100 μsec pulse should shift right 1 msec for each step of the MSD decade switch. Shift the scope to U18-9, leaving the trigger at U16-1 for the final checks. For MSD positions 1, 2 and 3, a 4 msec pulse fills the first 4 msec of a 12 msec display. MSD positions 4 through 7 fill the center 4 msec of the display and positions 8 through 11 fill the last 4 msec of the display. When checking at U18-13 with the fourth MSD and at U18-10 with the MSD additional pulses will appear 4 μsec and 4 msec to the right of the basic pulse. These are a result of two decade switches controlling one gate input and can be ignored. Repair as required then repeat step 49.		
51	Does the scope show a positive pulse (to +7V dc) for 10 msec then a negative pulse (to 0V dc) for 3 msec at tp3?	53	52
52	Verify the voltage magnitude is set for 1 volt on the 10-Volt range at 1 kHz. Check the Flip-Flop and FET switches for the following typical voltages. The emitter junction of Q12/Q13 should be ≈−10.31V dc, the base of Q12 ≈−9.59V dc, the collector of Q12 ≈−7.8V dc, the base of Q13 ≈−9.88V dc, the collector of Q13 ≈+3.00V dc and the emitter of Q8 ≈+6.4V dc. The gate of Q9 should have a positive pulse (to +7V dc) for 10 msec then a negative pulse (to −10V dc) for 3msec. The gate of Q11 should have a positive pulse (to Zero V dc) for 10 msec then a negative pulse (to −10V dc) for 3msec. Repair as required then repeat step 51.		
53	Check the Active filter for +3 mV dc at U31-2, 0V dc at U31-3, +6 mV dc at U31-6, +2 mV dc at U32-2, 0V dc at U32-3 and +3 mV dc at U32-6. Check the associated components in the 5-pole active filter. Repair as required repeat the test starting at step 35.		

Table 4-16. REFERENCE ASSEMBLY A12 (Cont.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
54	Is an RCU installed in the 5200A?	55	58
55	Repeat the linearity checks in steps 35 through 41 using the RCU to input the voltage magnitude.		
56	Are the RCU instigated voltages linear?	58	57
57	Check the RCU output, the interconnecting circuits on the Mother Assembly, and the input gates U1 through U11. Repair as required then repeat the test starting at step 55.		
58	The test of the Reference Assembly is now complete. If any component was replaced or an adjustment changed a calibration procedure should be performed.		

Table 4-17. STANDARD INSIDE THE GUARD REGULATOR VOLTAGES (Regulator Subassembly)

VOLTAGE AND TOLERANCE	EXTENDER TEST POINTS		LOAD ACROSS EXTENDER TEST POINTS		LOAD VALUE	RIPPLE PEAK TO PEAK		CHANGE IN VOLTAGE NO LOAD to LOAD	CHANGE IN VOLTAGE FOR ±10% LINE VARIATION	
	HI	LO				NO LOAD	LOAD		NO LOAD	LOAD
+15 ±0.5	57	51	58	52	150 Ω	< 1 mV	< 5 mV	< – 30 mV	< 5 mV	< 10 mV
–15 ±1.0	59	51	60	52	150 Ω	< 1 mV	< 5 mV	< –400 mV	< 10 mV	< 30 mV
–30 ±1.0	53	51	54	52	270 Ω	< 2 mV	< 10 mV	< –100 mV	< 10 mV	< 40 mV
+30 ±1.0	55	51	56	52	270 Ω	< 2 mV	< 10 mV	< –300 mV	< 10 mV	< 40 mV
+5 ±0.25	67	51	70	66	10 Ω	< 1 mV	< 2 mV	< ± 10 mV	< 5 mV	< 10 mV

Table 4-18. FLOATING INSIDE THE GUARD REGULATOR VOLTAGES (Regulator Subassembly)

VOLTAGE AND TOLERANCE	EXTENDER TEST POINTS		LOAD ACROSS EXTENDER TEST POINTS		LOAD VALUE	RIPPLE PEAK TO PEAK		CHANGE IN VOLTAGE NO LOAD to LOAD	CHANGE IN VOLTAGE FOR ±10% LINE VARIATION	
	HI	LO				NO LOAD	LOAD		NO LOAD	LOAD
+6.955 ±0.005	38	43	N/A	N/A	N/A	< 20 mV	N/A	N/A	< 5 mV	N/A
+20 ±0.25	39	43	39	43	270 Ω	< 50 mV	< 50 mV	< ±200 mV	< 100 mV	< 400 mV
+15 ±0.1	34	43	33	44	150 Ω	< 5 mV	< 5 mV	< ±100 mV	< 5 mV	< 5 mV
–15 ±0.5	35	43	36	44	150 Ω	< 10 mV	< 15 mV	< ±200 mV	< 5 mV	< 10 mV

Table 4-19. OUTSIDE THE GUARD REGULATOR VOLTAGES (Power Supply Subassembly)

VOLTAGE AND TOLERANCE	EXTENDER TEST POINTS		LOAD ACROSS EXTENDER TEST POINTS		LOAD VALUE	RIPPLE PEAK TO PEAK		CHANGE IN VOLTAGE NO LOAD to LOAD	CHANGE IN VOLTAGE FOR ±10% LINE VARIATION	
	HI	LO				NO LOAD	LOAD		NO LOAD	LOAD
+ 5 ±0.5V	42	3	41	4	10 Ω	< 1 mV	< 1 mV	< ± 50 mV	< 1 mV	< 1 mV
+15 ±1.0V	5	3	6	4	270 Ω	< 10 mV	< 30 mV	< ±300 mV	< 300 mV	< 300 mV
–15 ±1.0V	1	3	2	4	270 Ω	< 5 mA	< 20 mV	< ±500 mV	< 100 mV	< 300 mV

Table 4-20. POWER SUPPLY R6 REPLACEMENT VALUES

If Reading is Between Vdc	Verify or Install Value of R6 in K Ohms	Fluke Part Number	If Reading is Between Vdc	Verify or Install Value of R6 In K Ohms	Fluke Part Number
6.80 - 6.86	1.65	293662	7.16 - 7.22	2.00	235226
6.87 - 6.93	1.74	344358	7.23 - 7.29	2.10	168237
6.94 - 7.01	1.82	293670	7.30 - 7.36	2.15	293712
7.02 - 7.08	1.87	267229	7.37 - 7.43	2.21	347476
7.09 - 7.15	1.91	236877	7.44 - 7.50	2.32	260315

Table 4-21. ATTENUATOR OUTPUT AND SENSE SIGNAL PATHS-OPERATE MODE.

RANGE	SM TYR	INPUT	100 Hz + 1 kHz	10 kHz + 100 kHz	1 MHz	OUTPUT
1000V [1]	OH	J33	K34 → K3A			R J32
	OL		K31B			
	SH	R J32	K3B → K32			W4 → P52
	SL		K31A			
100V	OH	J33	K1			F W1 → P30
	OL		W3B			R W2 → J31
	SH	F P30-W1-W2	R8 → R9 → K27			W4 → P52
	SL	R J31	R10 → R9			
10V	OH	J33	K1			F W1 → P30
	OL		W3B			R W2 → J31
	SH	F P30 → W1	K8 → K10A → T1P → K10B → K32	K8 → K12B → T2P → K12A → K32	K8 → K14B → T3P → K14A → K32	W4 → P52
		R J31 → W2				
	SL	F P30-W1-W2	→ K29 → K33 → T1P	→ K29 → K33 → T2P	→ K29 → T3P	
		R J31				
1V	OH	J33	K34 → K4 → T1P → T1S → K15 → K2	K34 → K5 → T2P → T2S → K19 → K2	K34 → K6 → T3P → T3S → K23 → K2	F W1 → P30
	OL		→ K28 → K33 → T1P → T1S → W3B	→ K28 → K33 → T2P → T2S → W3B	→ K28 → T3P → T3S → W3B	R W2 → J31
	SH	F P30 → W1	K8 → K7 → K32			W4 → P52
		R J31 → W2				
	SL	F P30 → W1 → W2				
		R J31				
100 mV 10 mV 1 mV	OH	J33	K34 → K4 → T1P → T1S → K16 → K17 → K18 → K2	K34 → K5 → T2P → T2S → K20 → K21 → K22 → K2	K34 → K6 → T3P → T3S → K24A → K25A → K26 → K2	F W1 → P30
ALL mV	OL		→ K28 → K33 → T1P → T1S → W3B	→ K28 → K33 → T2P → T2S → W3B	→ K28 → T3P → T3S [2] → W3B	R W2 → J31
	SH	[3]	T1S → K9 → K32	T2S → K11 → K32	T3S → L1 + L2 → K13 → K32	
	SL	F P30-W1-W2	[3] →			W4 → P52
		R J31				

1 1000V Range is used only in conjunction with 5205A Power Amplifier.

2 W3F K24B Parallels W3B in the 100 mV range, W3D K25B parallels W3B in the 10 mV Range.

3 Internal sensing only on mV Ranges, sense HIGH from Xfrmr secondaries,sense LOW from A3K3.

Note that A3K3 also ties sense and output high together behind the front terminals, but the sense HIGH signal path from front or rear terminals is not connected to W4.

OH = OUTPUT HIGH
OL = OUTPUT LOW
SH = SENSE HIGH
SL = SENSE LOW

F = FRONT
R = REAR
P = PLUG
J = JACK

W = CABLE
K = RELAY
R = RESISTOR

TnP = XFMR PRIMARY
TnS = XFMR SECONDARY

Table 4-22. POWER AMP AND ATTENUATOR OUTPUT AND SUBSTITUTE SENSE SIGNAL PATHS–STANDBY MODE

RANGE	INPUT	SIG TYPE	100 Hz & 1 kHz	10k / 100k	1 MHz	OUTPUT	SIG TYPE
ALL VOLTS + MV	J33	PAOH	K34 → K4 → T1P → T1S → K9	K34 → K5 → T2P → T2S → K11	K34 → K6 → T3P T3S → L1 + L2 → K13	K34 → K4 → P52	SSH
		PAOL	→ T1S → K28 → K33 → T1P	→ T2S → K28 → K33 → T2P	→ T3S → K28 → T3P	K29 → W4 → P52	SSL

Note: K1, K2, K8, & K27 open during standby disconnecting output & sense high signal paths from the front and rear of A6, output & sense low signal paths remain connected to front and rear of A6 during STANDBY.

PAOH = POWER AMPLIFIER A7 OUTPUT HIGH
PAOL = POWER AMPLIFIER A7 OUTPUT LOW
SSH = SUBSTITUTE SENSE HIGH
SSL = SUBSTITUTE SENSE LOW

P = PLUG
J = JACK
K = RELAY
TP = XFMR PRIMARY

TS = XFMR SECONDARY

Table 4-23. ATTENUATOR MODE AND VOLTAGE RANGE LOGIC INPUTS AND OUTPUTS.

P30 PINS		34	38	40	36	0	1	2	3	4	5	6	7	U10 OUTPUT LOGIC									
U10 PINS		12	13	14	15	1	2	3	4	5	6	7	9	U10 PINS									
MODE	RANGE	STD By	$\overline{R4}$	$\overline{R2}$	$\overline{R1}$	$\overline{H}$	$\overline{G}$	$\overline{F}$	LOGIC LINES					D	E	F	G	H	K	L	M	N	$\overline{D}$
OPER.	1 mV	0	1	1	0	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	1	0
	10 mV	0	1	0	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0	0
	100 mV	0	1	0	0	1	1	1	1	0	1	1	1	1	1	0	0	0	0	1	0	0	0
	1 V	0	0	1	1	1	1	1	0	1	1	1	1	0	1	0	0	0	1	0	0	0	1
	10 V	0	0	1	0	1	1	0	1	1	1	1	1	0	0	1	0	0	0	0	0	0	1
	100V	0	0	0	1	1	0	1	1	1	1	1	1	0	0	0	1	0	0	0	0	0	1
	1000V	0	0	0	0	0	1	1	1	1	1	1	1	0	0	0	0	1	0	0	0	0	1
STDBY	ANμ	1	X	X	X	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0
OPER	NON-	0	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0
STDBY	LEGAL	1	1	1	1	1	1	1	1	1	1	1	0	1	1	0	0	0	0	0	0	1	0

1 = TRUE = HIGH = +2.0 to +5.0 Volts or Open Circuit

0 = FALSE = LOW = 0.0 to +0.8 Volts

USE P30 PIN 81 AS COMMON

Table 4-24. ATTENUATOR FREQUENCY RANGE LOGIC.

P30 PINS	42	52	50	A6 LOGIC		
FREQ RANGE	R4	R2	R1	A	B	C
100 Hz	1	1	1	1	0	0
1 kHz	1	1	0	1	0	0
10 kHz	1	0	1	0	1	0
100 kHz	1	0	0	0	1	0
1 MHz	0	1	1	0	0	1

1 = TRUE = High = +2.0 to +5.0V or Open Circuit
0 = FALSE = Low = 0.0 to +0.8 Volts

A = 100 Hz or 1 kHz
B = 10 kHz or 100 kHz
C = 1 MHz

NOTE: FREQ RNG 1 enters A6 on P20 PIN 50 but is not used on this PCB.

Use P30 Pin 81 as common.

1 = TRUE = High = +2.0V to +5.0Volts dc or Open Circuit
0 = FALSE = Low = 0.0 to +0.8V dc.

Table 4-25. AC–DC CONVERTER BUFFER AMPLIFIER TEST POINTS

NOTE: **All voltage figures are typical. The AC figures are given as 1 volt rms less a percentage figure. With an AC Differential Voltmeter set at 1 volt rms (in the Null Mode) the reading can be made directly from the meter.**

Test Points	DC	AC	Test Points	DC	AC
CR1 Cathode	+18.6V		Q5 Collector	+1.6V	7Vrms - 0.055%
CR4 Cathode	+14.3V		Q10 Collector	-0.7V	1Vrms - 0.1%
CR5 Anode	+7.0V	1Vrms - 1.42%	CR7 Cathode	-8.2V	
CR3 Cathode	+8.2V	1Vrms - 0.85%	C23 (+)	0 ± 4mV	1Vrms - 0.1%
CR3 Anode	0 ± 0.02V	1Vrms - 0.85%	R5/C3	0 ± 0.5V	1Vrms - 0.05%
CR2 Cathode	+13.1V	1Vrms - 1.0%	U4 pin 6	+0.13V	
Q8 Basa	+14.14V	1Vrms - 0.8%	U4 pin 2	0 ± 100μV	
Q8 Collector	+5.8V	1Vrms - 1.4%	U4 pin 3	0 ± 100μV	

Table 4-26. OSCILLATOR CONTROL ASSEMBLY TEST POINTS

TEST POINT	A10 OSCILLATOR INSTALLED AND UNIT OSCILLATING		A10 OSCILLATOR REMOVED OR UNIT NOT OSCILLATING
	(1.2V on 1VR)	(.1V on 1VR)	
TP7	–12V dc	–1V dc	–15V dc
Emitter Q2	+1.2V dc		–0.12V dc
Emitter Q3	+0.55V dc		–0.55V dc
Cathode CR78	+0.9V dc	–7 mV dc	–1.57V dc
TP5	0 ±10 mV dc		–1.1V dc
Source Q5/Q6	+1.3V dc		+0.86V dc
Base Q7	+8.5V dc		+8.4V dc
Base Q8	+0.74V dc		+9.12V dc
TP6	0 ±0.5V dc		+8.5V dc
Collector Q11	1.2V p-p pulses		+0.6V dc
Collector Q12	1.2V p-p pulses		–0.6V dc

Table 4-27. OSCILLATOR CONTROL ASSEMBLY HI-FREQ. ROLLOFF COMPENSATOR CHECKS

TEST POINT	A10 OSCILLATOR INSTALLED AND UNIT OSCILLATING @ 1 kHz	A10 OSCILLATOR REMOVED OR UNIT NOT OSCILLATING
U3 pin 14	+0.2V dc	+66 mV dc
Base Q18	0 ±10 mV dc	+ 0.2 V dc
Base Q26	+11.4V dc	+11.5 V dc
Collector Q26	+4.8V dc	+4.98 V dc
Emitter Q18	–0.66V dc	–0.87 V dc
Emitter Q27	–0.66V dc	–0.66 V dc

Table 4-28. OSCILLATOR CONTROL FREQUENCY RANGE TEST POINTS

MNEMONIC	TEST POINT (X @ EXTENDER) PIN	FREQUENCY RANGE SELECTED				
		100 Hz	1 kHz	10 kHz	100 kHz	1 MHz
FREQ RNG 1	X-25	High	Low	High	Low	High
FREQ RNG 2	X-27	High	High	Low	Low	High
FREQ RNG 4	X-29	High	High	High	High	Low
10 kHz	U4-8	High	High	Low	High	High
1 kHz + 100 Hz	U4-11	Low	Low	High	High	High
100 Hz	U5-9	Low	High*	High*	High*	High*
1 kHz	U5-7	High*	Low	High*	High*	High*
10 kHz	U5-6	High*	High*	Low	High*	High*
100 kHz	U5-5	Floating	Floating	Floating	Low	High*
1 MHz	U5-4	Floating	Floating	Floating	Floating	Low
1 MHz Drive	X-50	Low	Low	Low	Low	High
100 Hz Drive	X-56	Low	High	High	High	High
100 Hz	X-54	Floating	Low	Low	Low	Low
A	Q14 Collector	+6.7V dc	−13.5V dc	−13.5Vdc	−13.5Vdc	−13.5Vdc
B	Q15 Collector	−13.5Vdc	+6.7Vdc	13.5V dc	−13.5Vdc	−13.5Vdc
C	Q16 Collector	−13.5Vdc	−13.5Vdc	+6.7Vdc	−13.5Vdc	−13.5Vdc
D	Q25 Collector	+6.7Vdc	+6.7Vdc	+6.7Vdc	+6.7Vdc	−11.5Vdc

High - Logic level is +2 to +5 Volts dc

High* - Logic level is near +15 Volts dc from the relay circuits

Low - Logic level is 0 to +0.8 Volts dc

Floating - Some undetermined voltage, varying with the test instrument used, but typically near 1 Volt. It results from the open collector outputs of the decoder.

Table 4-29. OSCILLATOR ASSEMBLY FREQUENCY MAGNITUDE SWITCH LOGIC

FRONT PANEL SWITCH SETTINGS					SCHEMATIC LOGIC LINES													
					B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S
–	1	0	0	0	L	L	L	H	L	L	L	L	L	L	L	L	L	L	L	L
–	1	1	1	1	L	L	L	H	L	L	L	H	L	L	L	H	L	L	L	H
–	2	2	2	2	H	L	L	L	L	L	H	L	L	L	H	L	L	L	H	L
–	3	3	3	3	H	L	L	H	L	L	H	H	L	L	H	H	L	L	H	H
–	4	4	4	4	L	H	L	L	L	H	L	L	L	H	L	L	L	H	LL	L
–	5	5	5	5	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H
	6	6	6	6	H	H	L	L	L	H	H	L	L	H	H	L	L	H	H	L
	7	7	7	7	H	H	L	H	L	H	H	H	L	H	H	H	L	H	H	H
	8	8	8	8	L	H	H	L	H	L	L	L	H	L	L	L	H	L	L	L
	9	9	9	9	L	H	H	H	H	L	L	H	H	L	L	H	H	L	L	H
1	0	0	0	0	H	H	H	L	L	L	L	L	L	L	L	L	L	L	L	L
1	1	9	9	9	H	H	H	H	H	L	L	H	H	L	L	H	H	L	L	H

H = High = True = 0V = FET ON

L - Low = False = –15V = FET OFF

Section 5
Lists of Replaceable Parts

TABLE OF CONTENTS

TABLE	ASSEMBLY NAME	REFERENCE DESIGNATOR	PART NO.	PAGE
5-1	Model 5200A AC Calibrator, Final Assembly	—	337816	5-3
5-2	Mother Board PCB Assembly	A2	396747	5-12
5-3	Switch/Display PCB Assembly	A3	396911	5-14
5-4	Power Supply Mother PCB Assembly	A5	332429	5-17
5-5	Power Supply PCB Subassembly	A5A1	332536	5-19
5-6	Regulator PCB Subassembly	A5A2	396739	5-21
5-7	Transformer PCB Subassembly	A5A3	332528	5-24
5-8	Attenuator PCB Assembly	A6	396721	5-25
5-9	Power Amplifier PCB Assembly	A7	396713	5-28
5-10	AC-DC Converter PCB Assembly	A8	401059	5-35
5-11	Oscillator Control PCB Assembly	A9	396705	5-42
5-12	Oscillator PCB Assembly	A10	396697	5-51
5-13	Reference PCB Assembly	A12	332650	5-59

NOTE

For Extender PCB Assembly (A4) and RCU PCB Assembly (A11), refer to Section 6, Options and Accessories.

5-1. INTRODUCTION

5-2. This section contains an illustrated parts breakdown of the instrument. Components are listed alphanumerically by assembly. Electrical components are listed by reference designation and mechanical components are listed by item number. Each listed part is shown in an accompanying illustration.

5-3. The parts list tables include the following information.

a. Reference Designation or Item Number

b. Description of each part

c. Fluke Stock Number

d. Federal Supply Code for Manufacturers (See Appendix A for Code-to-Name list)

e. Manufacturer's Part Number or Type

f. Total Quantity per assembly or component

g. Recommended Quantity: This entry indicates the recommended number of spare parts necessary to support one to five instruments for a period of two years. This list presumes an availability of common electronic parts at the maintenance site. For maintenance for one year or more at an isolated site, it is recommended that at least one in each assembly in the instrument be stocked. In the case of optional subassemblies, plug-ins, etc. that are not always part of the instrument, or are deviations from the basic instrument model, the REC QTY column lists the recommended quantity of the item in that particular assembly.

h. Use Code is provided to identify certain parts that have been added, deleted or modified during production of the instrument. Each part for which a use code has been assigned may be identified with a particular instrument serial number by consulting paragraph 5-7.

5-4. HOW TO OBTAIN PARTS

5-5. Components may be ordered directly from the manufacturer by using the manufacturer's part number, or from the John Fluke Mfg. Co., Inc. factory or authorized representative by using the FLUKE STOCK NUMBER. In the event the part you order has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and, if necessary, installation instructions.

5-6. To ensure prompt and efficient handling of your order, include the following information:

a. Quantity

b. FLUKE Stock Number

c. Description

d. Reference Designation or Item Number

e. Printer Circuit Board Part Number

f. Instrument model and Serial Number

5-7. USE CODE EFFECTIVITY LIST

USE CODE	SERIAL NUMBER EFFECTIVITY

Table 5-1. FINAL ASSEMBLY

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	FINAL ASSEMBLY						
	(Figure 5-1 thru 5-5)						
	Dial Assembly View (Figure 5-1)						
1	Chain drive (8.15 links/inch)	335273	89536	335273	28 in.		
2	Dial Assembly (5200A-4201)	338715	89536	338715	2		
3	Dial Assembly (5200A-4202)	338723	89536	338723	2		
4	Dial Assembly (5200A-4203)	338731	89536	338731	2		
5	Dial Assembly (5200A-4304)	338749	89536	338749	1		
6	Dial Assembly (5200A-4305)	338756	89536	338756	1		
7	Dial Screened	350587	89536	350587	5		
8	Dial Screened	350595	89536	350595	3		
9	Plate, Detent, Mounting	329490	89536	329490	1		
10	Shaft and Index Assembly, Switch, 10 position (Voltage digits 3 thru 7, Frequency digits 3, 4 and 5)	334359	89536	334359	8		
11	Shaft and Index Assembly, Switch, 11 position (Voltage and Frequency digits 2)	334367	89536	334367	2		
12	Shaft and Index Assembly, Switch, 7 position (Voltage Range)	334375	89536	334375	1		
13	Shaft and Index Assembly, Switch, 5 position (Frequency Range - Hz)	334383	89536	334383	1		
14	Shaft and Index Assembly, Switch, 2 position (Control, Phase Lock, Sense)	334391	89536	334391	3		
15	Shaft and Index Assembly, Switch, 3 position (Voltage Error - %)	334409	89536	334409	1		
16	Shaft and Index Assembly, Switch, 3 position (Mode)	334417	89536	334417	1		
17	Shaft and Index Assmebly, Switch, 2 position (POWER)	335661	89536	335661	1		
18	Shaft and Index Assembly, Switch, 12 position (Voltage and Frequency digits 1 and measure unit modifiers)	334433	89536	334433	4		

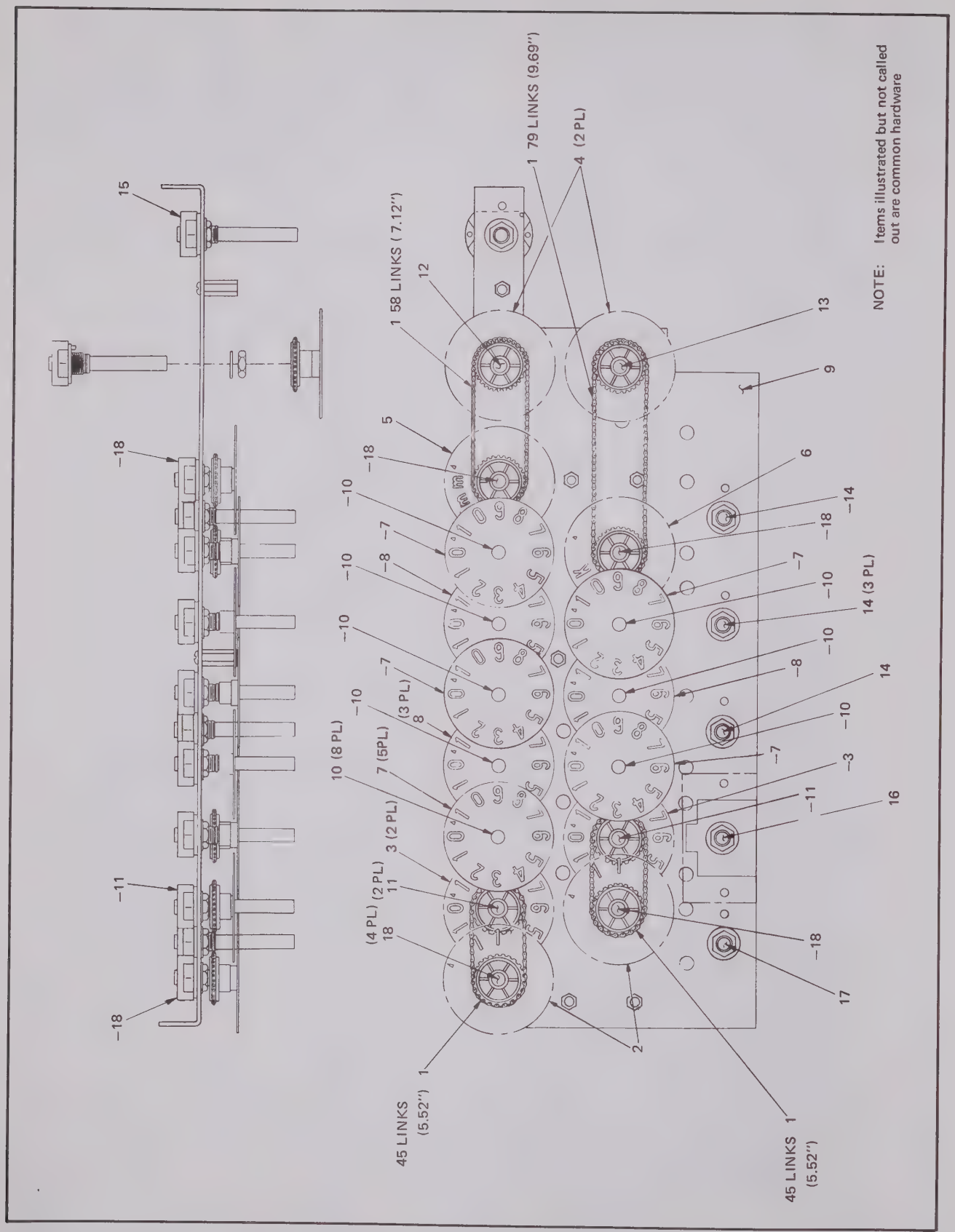


Figure 5-1. DIAL ASSEMBLY VIEW

Table 5-1. FINAL ASSEMBLY, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Front Panel View (Figure 5-2)						
A2	PCB Assembly, Mother Board	396747	89536	396747	1		
A3	PCB Assembly, Switch	396911	89536	396911	1		
19	Bezel, dial readout	341610	89536	341610	14		
20	Window readout	341719	89536	341719	1		
21	Bracket, corner angle	351635	89536	351635	2		
22	Connector, power switch	332171	89536	332171	1		
23	Decal	343376	89536	343376	1		
24	Handle, corner angle (front)	295675	89536	295675	2		
25	Name plate	194183	89536	194183	1		
26	Panel, Front	329482	89536	329482	1		
27	Panel, Extruded (front)	341776	89536	341776	1		
28	Plate, Central	329508	89536	329508	1		
29	Plate, Standoff, switch	337196	89536	337196	1		
30	Switch shaft, insulator	349647	89536	349647	17		
	Interior View (Figure 5-3)						
A5	PCB Assembly, Mother Power Supply, Coded Red (See Table 5-4)	332429	89536	332429	1		
	Special handling required for replacement, refer to table 5-4						
A5A1	Power Supply PCB Subassembly Coded Black (See Table 5-5)	332536	89536	332536	1		
A5A2	Regulator PCB Subassembly Coded Brown (See Table 5-6)	396739	89536	396739	1		
A5A3	Transformer PCB Subassembly (See Table 5-7)	332528	89536	332528	1		
A6	PCB Assembly, Attenuator Coded Orange (See Table 5-8)	396721	89536	396721	1		
A7	PCB Assembly, Power Amplifier Coded Yellow (See Table 5-9)	396713	89536	396713	1		
A8	PCB Assembly, AC-DC Converter Coded Green (See Table 5-10)	401059	89536	401059	1		
A9	PCB Assembly, Oscillator Control Coded Blue (See Table 5-11)	396705	89536	396705	1		

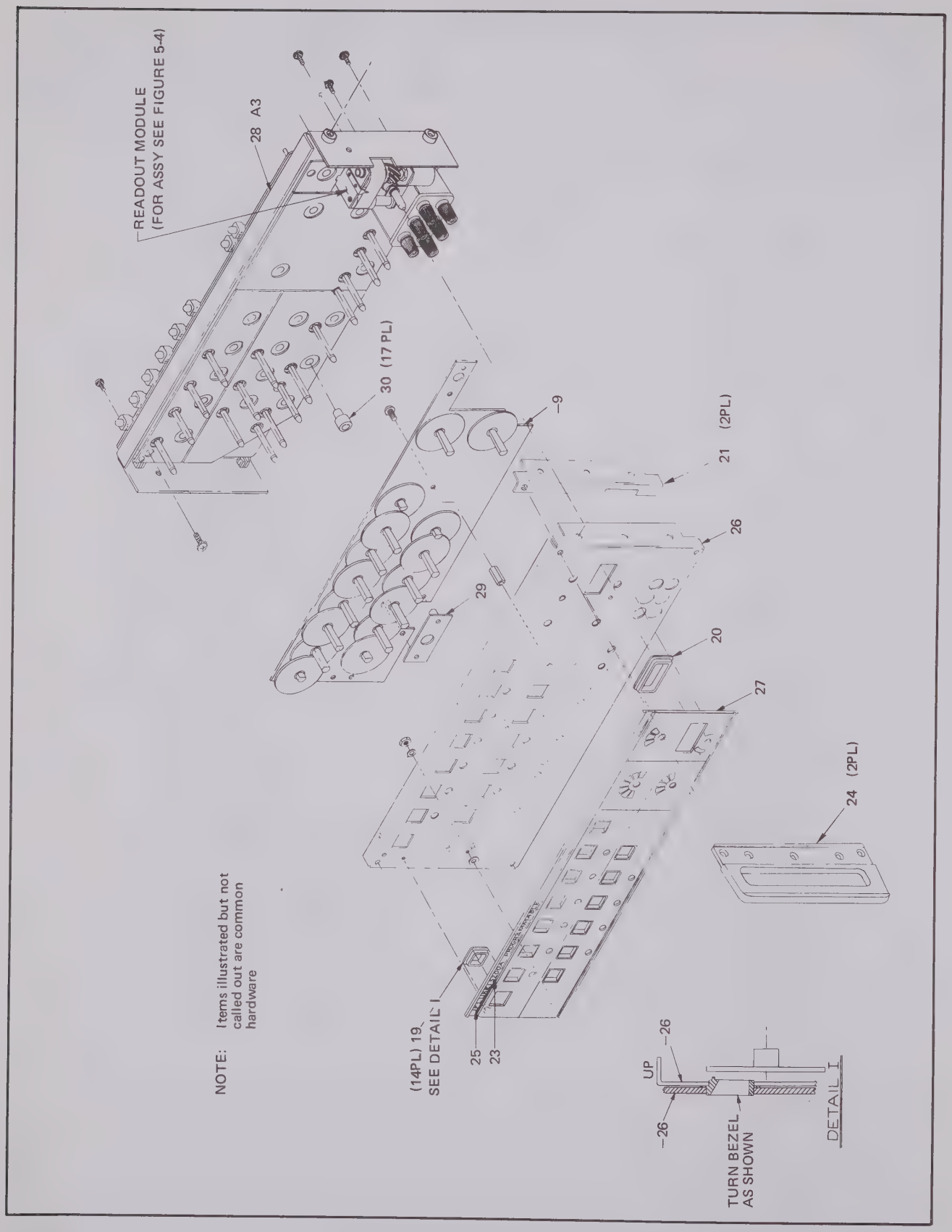


Figure 5-2. FRONT PANEL VIEW

Table 5-1. FINAL ASSEMBLY, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	PCB Assembly, Oscillator Coded Violet (See Table 5-12)	396697	89536	396697	1		
A12	PCB Assembly, Reference Coded White (See Table 5-13)	332650	89536	332650	1		
B1	Fan, "whisper", Veuturi	255562	82877	Order by Description	1		
F1	Fuse, Slo-Blo 1.5 amp	109231	71400	MDX15A	1	5	
XF1	Fuseholder low profile, gray	295741	75915	348-6-9-9	1		
J1	Connector, bulkhead, male, 3 pin	284166	82389	EAC301	1		
W1	Harness, Power	345801	89536	345801	1		
W2	Cable Assembly, RF	353375	89536	353375	1		
W3	Cable Assembly, RF	353383	89536	353383	1		
W4	Cable Assembly, RF	353391	89536	353391	1		
31	Bracket, corner angle	298166	89536	298166	2		
32	Chassis, side	329516	89536	329516	2		
33	Housing Assembly, fan	337667	89536	337667	1		
34	Filter	313056	89536	313056	1		
35	Filter Bracket	349696	89536	349696	1		
36	Knob, Knurled (Voltage and Frequency except far left, Vernier) (Black decal on black)	341446	89536	341446	9		
37	Knob, pointer (Power) (Green decal on Gray)	341339	89536	341339	1		
38	Knob, pointer (MODE, CONTROL, PHASE LOCK, SENSE) (Gray decal on Gray)	341404	89536	341404	4		
39	Knob, pointer (VOLTAGE RANGE, VOLTAGE ERROR - % FREQUENCY RANGE - Hz) (Black decal on black)	341453	89536	341453	3		
40	Knob, four-bar (far left VOLTAGE and FREQUENCY) Black decal on black	341370	89536	341370	2		
41	Panel, Rear	331934	89536	331934	1		
42	Inserter retainer, PCB	400952	89536	400952	1		
43	Shield, Bottom	332015	89536	332015	1		
44	Xfmr, panel, left	332254	89536	332254	1		

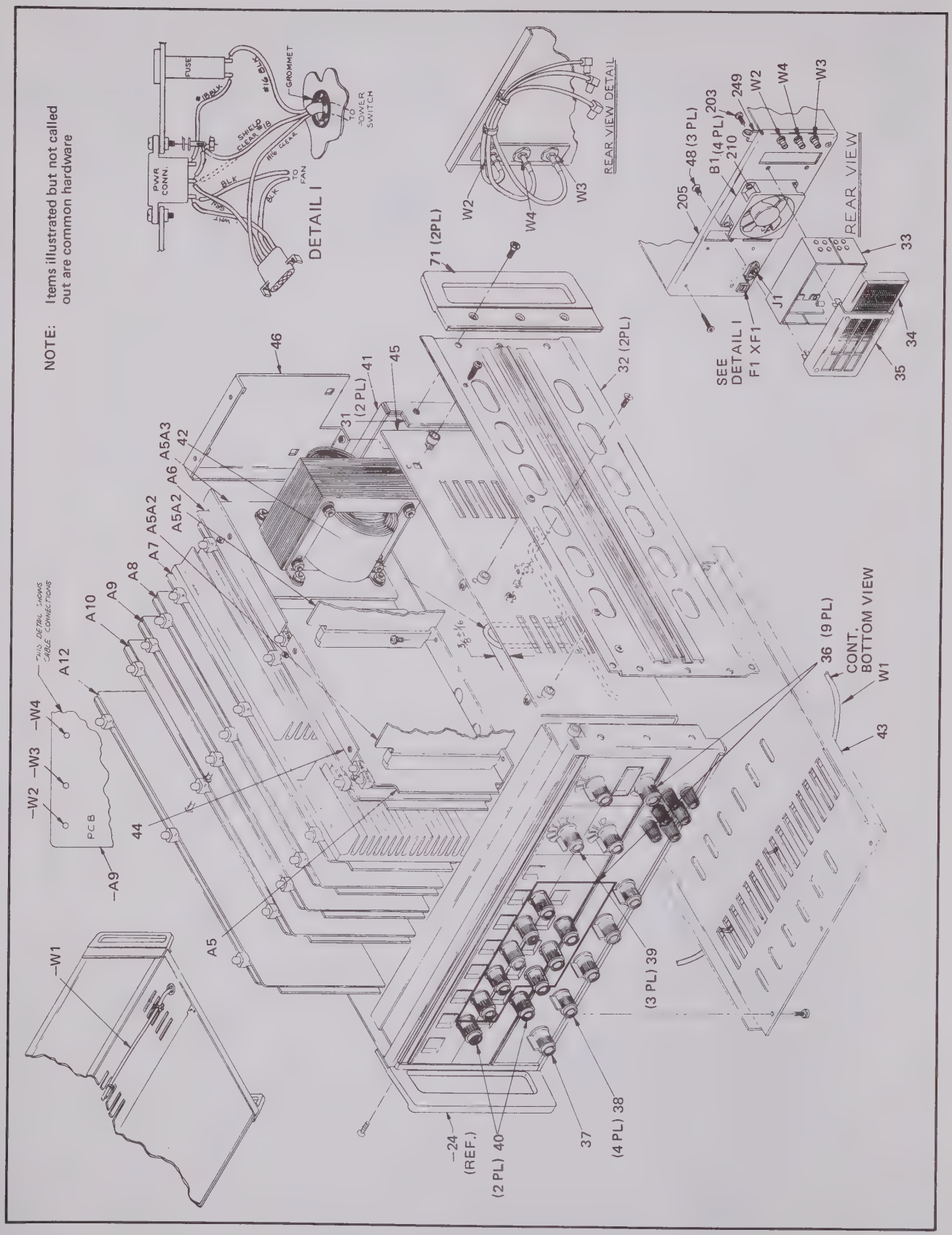


Figure 5-3. INTERIOR VIEW

Table 5-1. FINAL ASSEMBLY, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
45	Xfmr, panel, right	329524	89536	329524	1		
46	Xfmr, panel, rear	331926	89536	331926	1		
71	Corner handle rear (Early models used the 3-inch wide handle, item 24, on the rear. Order two if the 4-inch handle is desired as a replacement for these units)	415349	89536	415349	2		
	Readout Module View (Figure 5-4)						
R1	Resistor, var, ww, 10 turn, 100K	331207	80294	35098-9-104	1	1	
47	Bracket, readout	331991	89536	331991	1		
47a	Angle Readout (in early models this item was an integral part of item 47, Bracket readout)	415794	89536	415794	1		
48	Drive, Assembly, drum	350082	89536	350082	1		
49	Gear, switch, pot shaft (Plstc)	154682	89536	154682	1		
50	Idler drum	416008	89536	416008	2		
51	Tape, metal (printed	335547	89536	335547	1		
52	Pointer, tape	338780	89536	338780	1		
53	Shaft, drum	332080	89536	332080	2		
54	Shaft, vernier	332072	89536	332072	1		
	Assembled View (Figure 5-5)						
55	Bail, footstand	292870	89536	292870	4		
56	Bail, full width	231407	89536	231407	1		
57	Connector cover (ATTENUATOR)	356089	89536	356089	2		
58	Connector cover (RCU)	356055	89536	356055	1		
59	Connector Assembly, Attenuator (Not Illustrated)	337675	89536	337675	1		
60	Connector Assembly Instruction Sheet (Not Illustrated)	356204	89536	356204	1		
61	Cord Set (Not Illustrated)	284174	89536	284174	1		
62	Cover, bottom	332114	89536	332114	1		
63	Cover, top	332106	89536	332106	1		
64	Decal, corner	296277	89536	296277	4		
65	Decal Handle	295501	89536	295501	4		
66	Decal Power 370221	370221	89536	370221	1		

Table 5-1. FINAL ASSEMBLY, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
67	Decal, Side	295394	89536	295394	2		
68	Decal, Top Cover, inside	356022	89536	356022	1		
69	Shield, Top	332007	89536	332007	1		
70	Xfmr, cover, top	331918	89536	331918	1		

NOTE: Items illustrated but not called out are common hardware

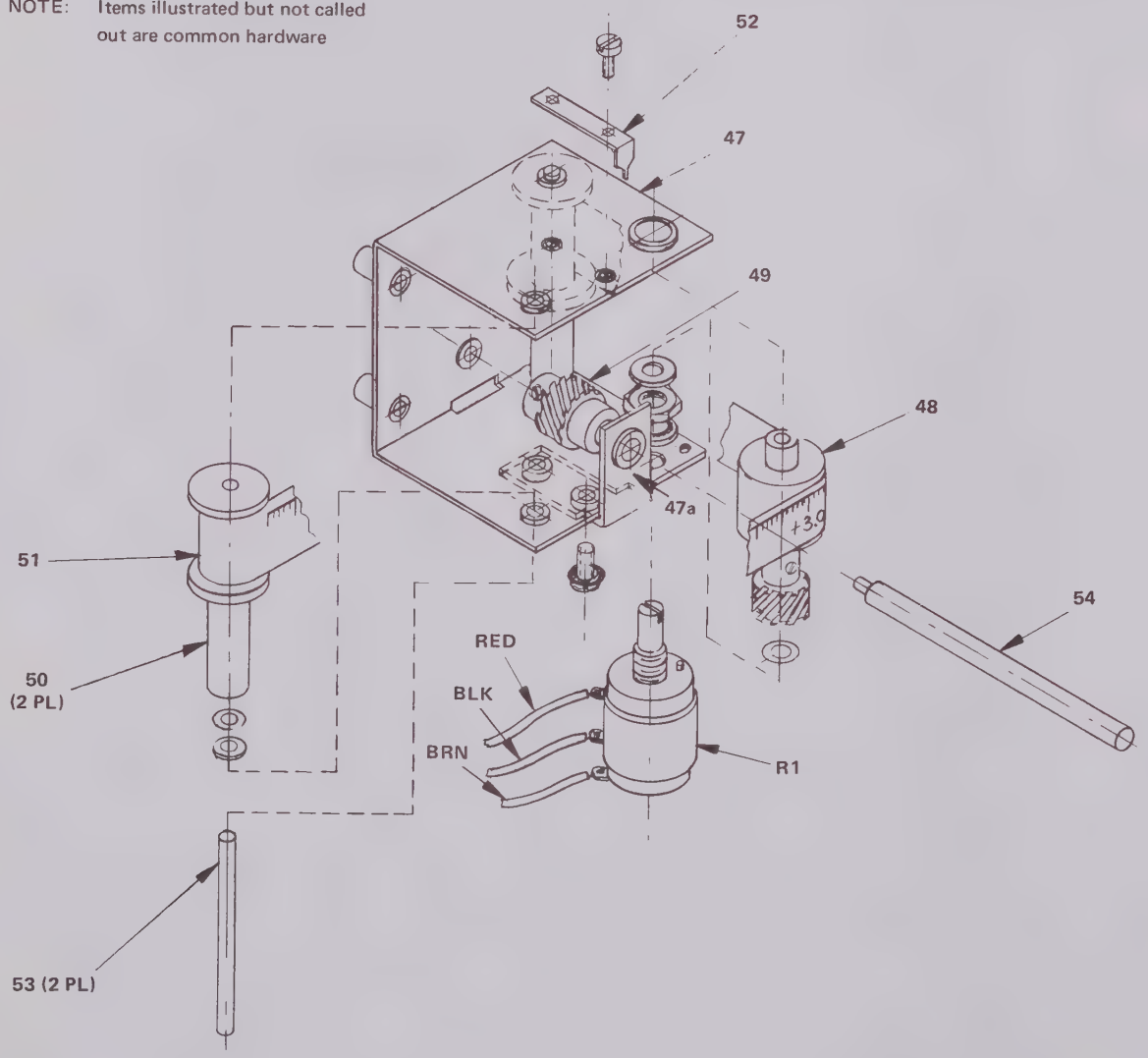


Figure 5-4. READOUT MODULE VIEW

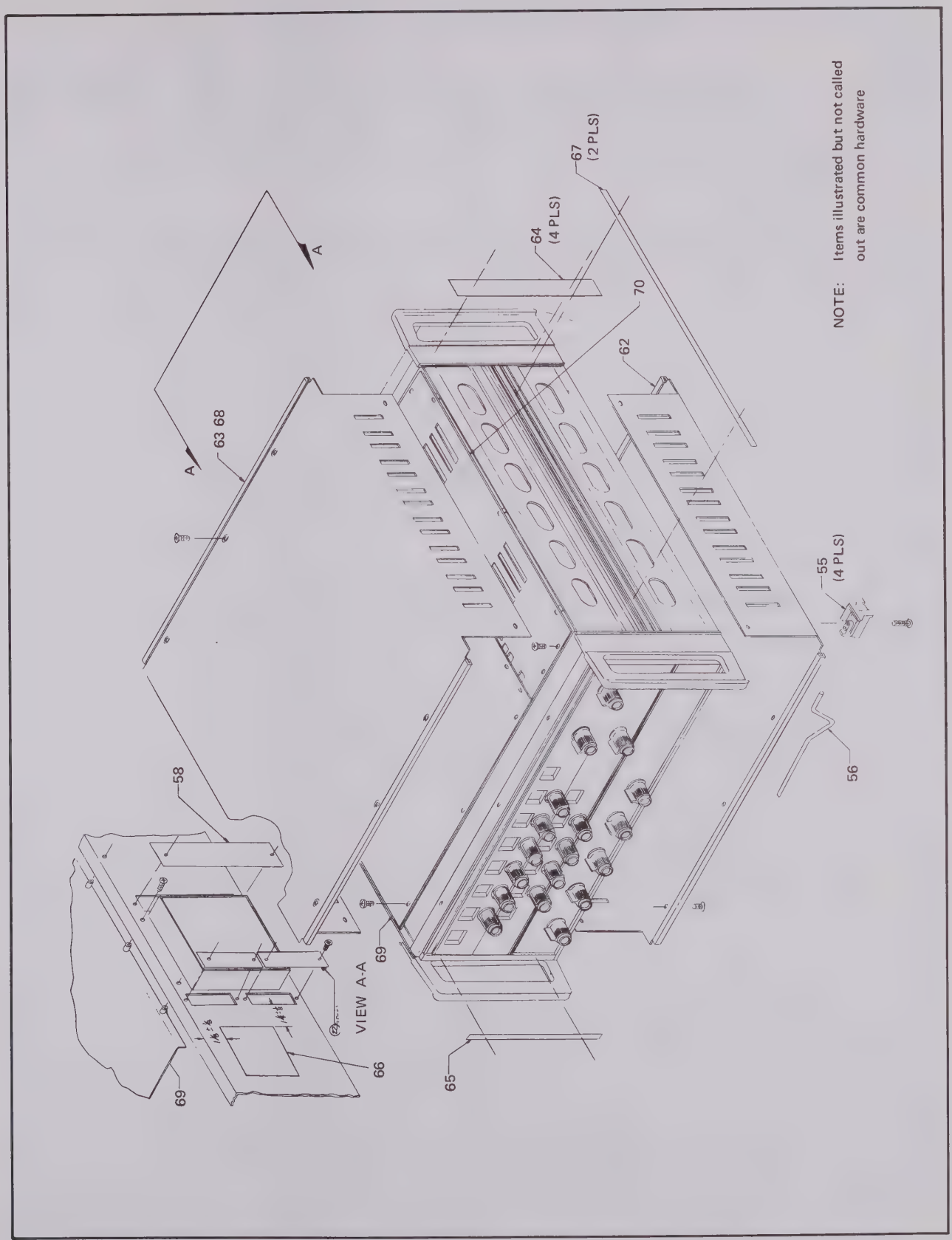


Figure 5-5. ASSEMBLED VIEW

Table 5-2. MOTHER BOARD, PCB ASSEMBLY, A2

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A2	**PCB Assembly, Mother Board (Figure 5-6)**	396747	89536	396747	REF		
1	Connector, card-edge	335281	71785	252-43-30-360	8		
2	Connector, male	267633	00779	86144-1	83		
1	Guide/retainer, red	339754	89536	339754	1		
2	Guide/retainer, orange	341099	89536	341099	1		
3	Guide /retainer, yellow	341107	89536	341107	1		
4	Guide/retainer, green	341115	89536	341115	1		
5	Guide/ retainer, blue	341123	89536	341123	1		
6	Guide/retainer, violet	341131	89536	341131	1		
7	Guide/ retainer, gray	341149	85936	341149	1		
8	Guide/ retainer, white	341156	89536	341156	1		
9	Harness, Mother board	350785	89536	350785	1		
	1 J20, J30, J40, J50, J60, J70, J80, J90						
	2 P1A thru P5A, P1B thru P21B, P1C thru P18C, P1D thru P12D, P1E thru P4E, P1F thru P4F, P1H, P3H, P4H, P6H thru P20H, P1K						

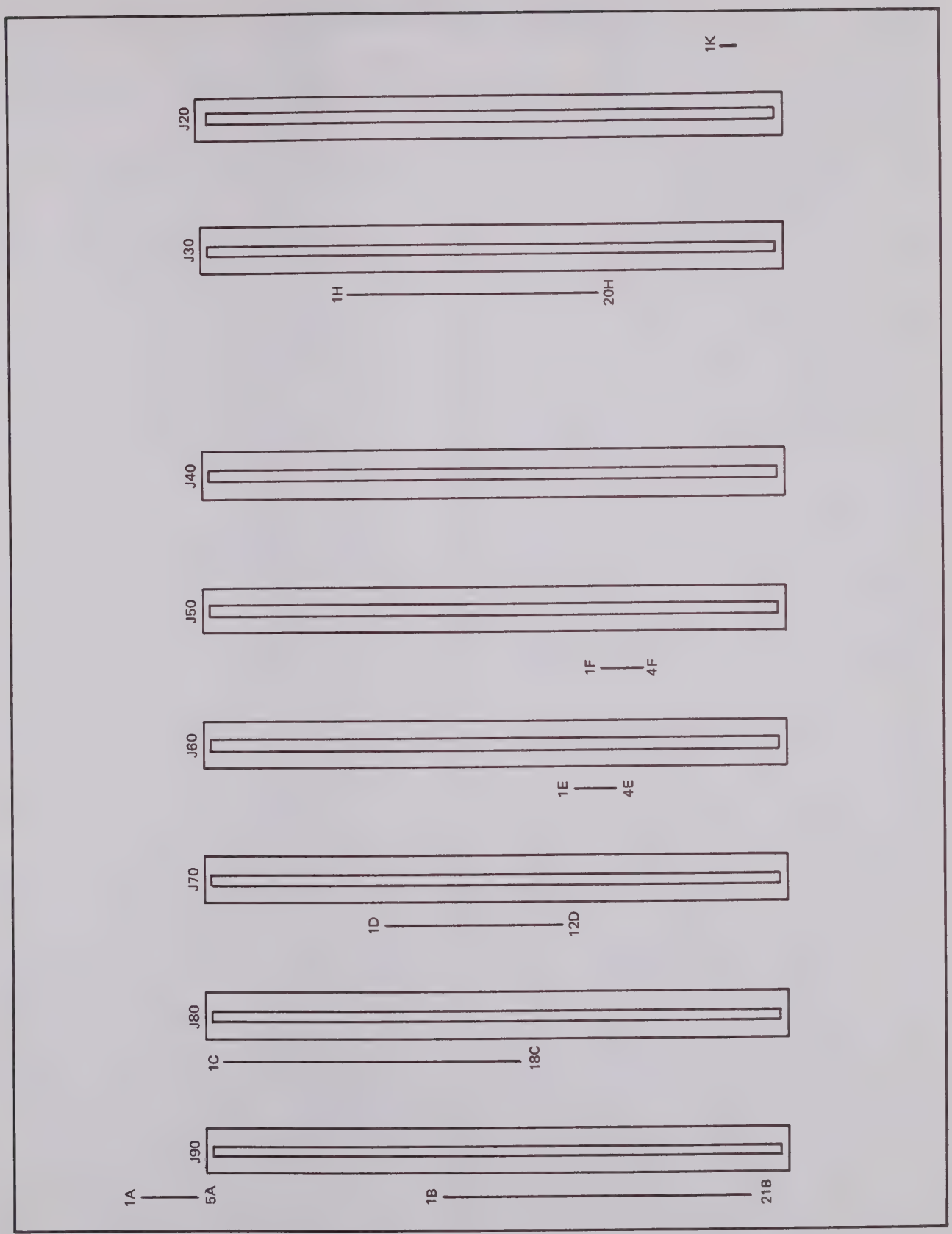


Figure 5-6. PCB ASSEMBLY, MOTHER BOARD

Table 5-3. SWITCH PCB ASSEMBLY, A3

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A3	**PCB Assembly, Switch (Figure 8-2)**	396911	89536	396911	REF		
C1	Cap, Ta, 1 uF ±20%, 35V	161919	56289	196D105X0035	1		
C2	Cap, Tant, 68 uF ±20%, 15V	193615	56289	196D686X0015 LA3	1		
C3	Cap, Tant, 0.22 uF ±20%, 35V	161331	56289	196D225X0035 HA1	1		
C4	Cap, Tant, 2.2 uF ±20%, 20V	161927	56289	196D225X0020 HA1	1		
C5	Cap, polyester, 0.022 uF ±10%, 250V	234484	73445	C280MAE22K	1		
CR1 thru CR8, CR10 thru CR21, CR38, CR39, CR46, CR47	Diode, Si, 150 mA	203323	07263	1N4148	24	5	
CR9	Not used						
CR22 thru CR37	Diode, light emitting (LED)	309617	71318	FLV102	16	4	
CR40, CR41, CR43, CR44, CR45, CR48	Diode, Ge, 80 mA, 100 piv	149187	93332	1N270	6	1	
CR42	Diode, Si	348177	03508	DA2429	1		
E1	Binding post, white (Ground)	275586	32767	820-25	1		
E2, E3	Binding post, red (OUTPUT HI, SENSE HI)	275552	32767	820-65	2		
E4	Binding post, blue (GUARD)	275578	32767	820-55	1		
E5,E6	Binding post, black (OUTPUT LO, SENSE LO)	275560	32767	820-45	2		
1	Connector, female	267591	00779	8586105	83		
	1 J1A thru J5A, J1B thru J21B J1C thru J18C, J1D thru J12D J1E thru J4E, J1F thru J4F, J1H						
K1, K2	Relay, reed, 210 ohms, 10%, 10W	340364	20891	1300-4-1A	2		

Table 5-3. SWITCH PCB ASSEMBLY, A3, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
K3	Relay, reed, DPST	340638	71482	MRB-2A05	1		
L1	Inductor, 1,000 uH, 140 mA	147819	72259	WEE-1,000	1		
Q1	Xstr, Si, pnp	195974	04713	2N3906	1	1	
Q2	Xstr, Si, npn	218396	04716	2N3904	1	1	
R1 thru R6, R8, R9,R29, R31, R32, R33	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	12		
R7,R28	Re, comp, 470 ±5%, ¼W	147983	01121	CB4715	2		
R10, R12, R13, R14, R17 thru R20	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	8		
R11, R16, R22, R26	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	4		
R15	Res, comp 15k ±5%, ¼W	148114	01121	CB1535	1		
R21	Not used						
R23, R24, R25	Res, comp, 6.2k ±5%, ¼W	221911	01121	CB6225	3		
R27	Res, comp, 68 ±5%, ¼W	147918	01121	CB6805	1		
R30	Res, mf, 68.1 ±0.5%, 1/8W	305995	91637	MFF1-868R10-PORM0.5PCT	1		
S1	Switch assembly, rotary, BCD 1-11, yellow	334284	89536	334284	1		
S2, S3, S4, S5	Switch assembly, rotary, BCD 0-9, white	334268	89536	334268	4		
S6,S10, S11,S12 S13*	Switch assembly, rotary, BCD 9-0 (FREQUENCY RANGE - Hz)* Red	334276	89536	334276	5		
S7	Switch assembly, rotary (VOLTAGE RANGE)	352948	89536	352948	1		
S8	Switch assembly, rotary (VOLTAGE ERROR) blue	334334	89536	334334	1		
S9	Switch assembly, rotary, BCD 11-1, green	386946	89536	386946	1		
S14	Switch assembly, rotary, (MODE) black	334342	89536	334342	1		

Table 5-3. SWITCH PCB ASSEMBLY, A3, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
S15, S16, S17	Switch assembly, rotary (CONTROL, PHASE LOCK SENSE) orange	334326	89536	334326	3		
U1, U6	IC, DTL, quad 2-input, NAND gate	268375	04713	MC846P	2	1	
U1,U12	IC, TTL, quad, 2-input pos NAND buffers	296228	12040	SN7437	2	1	
U3	IC, TTL, hex inverter buffer/driver	288605	12040	SN7416	1	1	
U4,U5	IC, TTL, decoder-driver	293175	12040	SN74145	2	1	
U7	IC, DCL, MSI, 4 Bit Digital comparator	293258	18324	N8242A	1		
U8	IC, TTL, MSI, Quad Latch	293241	07263	9314P/C	1		
U9	IC, TTL, Digital Positive NAND Gates	292953	01295	SN7400J	1		
U10	IC, TTL, Retriggerable Monostable Multivibrator	293134	07263	U6A960159X	1		
U11	IC, TTL, SSI, Hex Quad Schmitt Triggers	354886	01295	SN7414	1		
W1	Cable assembly, Output	346247	89536	346247	1		
W2	Wire assembly (to Ground term. E1)	353615	89536	353615	1		
W3	Wire assembly (to GUARD term. E4)	353607	89536	353607	1		
W4,W7	Wire assembly, Black	353342	89536	353342	2		
W5,W6	Wire assembly, Red	353334	89536	353334	2		
XCR22 thru XCR28 XCR33 XCR37	Socket, standoff, Light Emitting Diode (LED)	345975	89536	345975	9		
XCR29 thru XCR32 XCR34 XCR35 XCR36	Socket, standoff, Light Emitting Diode (LED)	345983	89536	345983	7		
XU1, XU2, XU3, XU6, XU7, XU9, XU10	Socket, IC, 14-contact	276527	23880	TSA-2900-14W	7		
XU4, XU5, XU8	Socket, IC, 16-contact	276535	23880	TSA-2900-16W	3		
1	Binding Post, insulated	298828	89536	298828	1		
2	Bracket, binding post	331967	89536	331967	1		
3	Clamp, cable	103796	95987	5-16-3NA	2		

Table 5-4. POWER SUPPLY MOTHER PCB ASSEMBLY, A5

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5	**PCB Assembly, Motherboard, Pwr Supply Power Supply (Figure 8-4a) ***	332429	89536	332429	REF		
C1,C2, C9,C10	Cap, elect, 400 uF +50%/−10, 40V	185868	73445	C437ARG400	4	1	
C3,C4	Cap, elect, 15 uF, 400V	341032	56289	39D156F400FL4	2	1	
C5,C6	Cap, elect, 240 uF, −10 +50%, 300V	223180	56289	36D241F300AB2A	2	1	
C7,C8	Cap, elect, 160 uF +50/−10%, 64V	170274	73445	C437ARH160	2	1	
C11	Cap, elect, 15,000 uF +75/−10%, 15V	310367	06001	86F520	1	1	
C12 thru C25	Not used						
C26	Cap, ta, 10 μF, ±20%, 15V	193623	56289	196D106X0015JA1	1		
C27	Cap, mylar, 5 uF ±5%, 150V	364190	50558	TYPE X564	1		
C28	Cap, mylar, 33 pF ±5%, 500V	160317	71236	DM15E330J	1		
CR1, CR2	Not Used						
CR3, CR6, CR7	Rectifier bridge, 2A, 100V	296509	21845	F903C-22	3	1	
CR4	Rectifier, bridge, 2A, 800V	341016	09423	FB800	1	1	
CR5	Rectifier, bridge, 2A, 600V	341008	09423	FB600	1	1	
CR8	Diode Bridge	428839	04713	MDA970-1	1	1	
CR9 thru CR15	Not Used						
CR16, CR17, CR19	Diode, Si	348177	03508	DA2429	3		
CR18, CR20	Diode, zener, 4-3V	180455	07910	1N749A	2		
J21	Connector, fem. 36-contact	236885	13511	225-21821-105	1		
J22, J23	Connector, card-edge	335281	71785	252-43-30-360	2		

Table 5-4. POWER SUPPLY MOTHER PCB ASSEMBLY, A5, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R1 thru R34	Not Used						
R35, R36, R44, R45	Res, comp, 680 ±%, ¼W	148007	01121	CB6815	2		
R37, R38	Res, comp, 750k ±5%, ½W	188789	01121	EB7545	2		
R39, R40	Res, comp, 200k ±5%, ½W	245332	01121	EB2045	2		
R43, R47, R49	Res, comp, 6.8k 5%, ¼W	148098	01121	CB6825	3		
R46	Res, comp, 10M ±5%, ¼W	194944	01121	CB1065	1		
R48	Res, comp, 30K ±5%, ¼W	193417	01121	CB3035	1		
Q1 thru Q17	Not Used						
Q18	Xstr, Si, PNP	195974	04713	2N3906	1		
U1 thru U4	Not Used						
U5	IC, Operational Amplifier	271502	12040	LM301	1		
1	Clamp, connector mounting	185801	56289	4586-97A	3		
2	Strap, rubber, round (mousetail)	104794	98159	2829-115-3	4		
3	Guide/retainer, red	339754	89536	339754	1		
4	Guide/retainer, brown	331975	89536	331975	1		
5	Guide/retainer, black	341164	89536	341164	1		
	* NOTE: Before ordering a new Power Supply Motherboard, visually examine the one being replaced for the part number etched on the component side of the pcb. If this number is either 332510 or 396929, order the replacement assembly, P/N 332429. In addition, P/N 332254 (Item 44; Xfmr, Panel left) is required to replace the non-compatible panel installed with those model power supply motherboard.						

Table 5-5. POWER SUPPLY PCB SUBASSEMBLY A5A1

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5A1	**PCB Subassembly, Power Supply (Figure 8-4b)**	332536	89536	332536	REF		
C1 thru C11,C15, C16,C17	Not used						
C12,C13	Cap, elect, 100 uF, ±5%, 40V	236919	73445	ET101X040A6	2	1	
C14	Cap, elect, 8,000 uF, 15V	341040	56289	39D808G015 JT4	1	1	
C18	Cap, mylar, 0.001 uF, ±10%	159582	56289	192P10292	1		
C19, C20	Cap, Ta, 10 uF, ±20%, 20V	330662	12954	D10GSB20M	2		
C21	Cap, Ta, 68 uF, ±10%, 15V	193615	56289	196D686X0015	1		
CR1	Rectifier bridge, 1.5A	296509	09423	FB200	1	1	
CR2	Rectifier bridge, 2.5A	236547	04713	MDA960-3	1	1	
CR3 thru CR8	Not used						
CR9, CR10	Diode, zener, 5 -10 mA, 16V, ±5%	325837	07910	1NC2322	1	1	
Q1	Xstr, Si, npn	203489	03508	11C2322	1	1	
Q2	Xstr, Si, pnp	218537	12040	NS1485	1	1	
Q3	Xstr, Si, npn	183012	86684	40251	1	1	
R1,R4	Res, comp, 12 , ±5%, ¼W	321083	01121	CB1205	2		
R2,R3	Res, comp, 1.8k, ±5%, ¼W	175042	01121	CB1825	2		
R5	Res, comp, 0.27, ±10%, 2W	219428	81483	Type BWH (include values ordering)	1		
R6	See U4						
R7	Res, met film, 4.99k, ±1%, 1/8W	168252	91637	MFF1-84991F	1		

Table 5-5. POWER SUPPLY PCB SUBASSEMBLY A5A1 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U1, U2 U3	Not used						
U4(R6)	IC, Voltage Regulator (selected set)	358143	89536	358143	1 set		
1	Strap, rubber, round (mousetail)	104794	98159	2829-115-3	2		
2	Guide/retainer, black	341164	89536	341164	2		
3	Heat sink, mtg.	342675	89536	342675	1		

Table 5-6. REGULATOR PCB SUBASSEMBLY A5A2

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5A2	**PCB Subassembly, Regulator (Figure 8-4c)**	396739	89536	396739	REF		
C1 thru C14	Not used						
C15	Cap, mica, 33 pF, ±5%, 500V	160317	53021	D15ED330J03	1		
C16	Cap, Ta, 0.22 uF, ±20%, 50V	309849	72982	8131-050-651-224M	1		
C17	Cap, cer, 500 pF, ±10%, 1 kV	105692	71590	2DDH60N501K	1		
C18 thru C21	Not used						
C22, C23, C24	Cap, Ta, 10 uF, ±20%, 20V	330662	12954	D10GSB20M	3		
C25	Cap, Ta, 1 uF, ±20%, 35V	161919	56289	196D105X0035	1		
CR1 thru CR10	Not used						
CR11	Diode, field effect	284927	07910	TCR5305	2	1	
CR12, CR14	Diode, current regulator	285106	07910	TCR5309	2	1	
CR13	Diode, zener, 5.6V	277236	07910	1N752A	1	1	
CR15	Diode, si, 150 mA	203323	03508	1N4148	1		
Q1 thru Q5,Q14	Not used						
Q6	Xstr, Si, npn	289819	95303	40409	1	1	
Q7, Q11, Q15	Xstr, Si, pnp	195974	04713	2N3906	3	1	
Q8, Q16	Xstr, Si, pnp	295188	95303	40410	2	1	

Table 5-6. REGULATOR PCB SUBASSEMBLY A5A2 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q9	Xstr, Si, npn	325761	06001	D44C5	1	1	
Q10	Xstr, Si, npn	218396	04713	2N3904	1	1	
Q12	Xstr, Si, pnp	325753	06001	D45C5	1	1	
Q13	Xstr, Si, npn	325720	04713	MFE3055	1	1	
Q17	Xstr, Si, npn	218511	95303	60994	1	1	
R1 thru R7, R9, R17, R20, R21, R24, R25	Not used						
R8, R10	Res, comp, 3.9, ±5%, ¼W	268722	01121	CB39G5	2		
R11, R13	Res, card set	339614	89536	339614	1 set		
R12	Res, comp, 22k, ±5%, ¼W	148130	01121	CB2235	1		
R14	Res, met film, 13k, ±1%, 1/8W	335539	91637	MFF1-81312F	1		
R15	Res, met film, 12.1k, ±1%, 1/8W	234997	91637	MFF1-81212F	1		
R16, R21	Res, comp, 20, ±5%, ¼W	246728	01121	CB2005	2		
R18	Res, met film, 13.7k, ±1%, 1/8W	236752	91637	MFF1-81372F	1		
R19	Res, met film, 15k, ±1%, 1/8W	285296	91637	MFF1-81502F	1		
R22	Res, met film, 20.5k, ±1%, 1/8W	261669	91637	MFF1-82052F	1		
R23	Res, met film, 11k, ±1%, 1/8W	293621	91637	MFF1-81102F	1		
R26	Res, met film, 4.75k, ±1%, 1/8W	260679	91637	MFF1-84751F	1		
R27	Res, met film, 4.22k, ±1%, 1/8W	168245	91637	MFF1-84221F	1		
R28	Res, comp, 2.4k, ±5%. ¼W	193433	01121	CB2425	1		

Table 5-6. REGULATOR PCB SUBASSEMBLY A5A2 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R29	Res, comp, 8.2, ±5%, ¼W	246751	01121	CB8225	1		
R30	Res, met film, 25.5k, ±1%, 1/8W	291377	91637	MFF1-82552F	1		
R31	Res, met film, 23.2k, ±1%, 1/8W	291351	91637	MFF1-82322F	1		
R32	Res, var, cermet, 1k, ±10%, ½W	285155	71450	360S-102A	1	1	
R33	Res, carbon, 2.4, ±5%, 1/3W	348508	89536	348508	1		
R34	Res, comp, 2k, ±5%, ¼W	202879	01121	CB2025	1		
R35	Res, comp, 1k, ±5%, ¼W	148023	01121	CB1025	1		
R36	Res, comp, 1.5k, ±5%, ¼W	148031	01121	CB1525	1		
U1	IC, operational amplifier	271502	12040	LM301A	1	1	
U2	IC, voltage regulator	313106	07263	U5R7723393	1	1	
U3	IC, voltage regulator, linear	327981	12040	LM309K	1	1	
1	Guide, retainer, brown	331975	89536	331975	2		
2	Heat dissipator	349688	89536	349688	1		
3	Heat sink, mtg.	342675	13103	6003-B-2	1		

Table 5-7. TRANSFORMER PCB SUBASSEMBLY A5A3

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A5A3	**PCB Subassembly, Transformer (Figure 8-4d)**	332528	89536	332528	REF		
J24	Conn, cable,	342964	27264	1490P1	1		
	Pins, conn, male	342998	27264	1376	4		
S1,S2	Switch, slide, DPDT	234278	82389	XW1649	2	1	
S3	Thermal switch (selected)	353235	89536	353235	1		
T1	Transformer, power	337576	89536	337576	1		
1	Connector post	267633	00779	86144-1	2		

Table 5-8. ATTENUATOR PCB ASSEMBLY, A6

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A6	**PCB Assembly, Attenuator (Figure 8-6)**	896721	89536	896721	REF		
A6A1	Connector (see end of table)						
C1	Cap, cer, 0.25 uF, ±20%, 100V	168435	56289	C023B101-H25 3M	1		
C2,C17	Cap, Ta, 5.6 uF ±10%, 6V	198259	56289	159D560-006A	2		
C3	Cap, var, 0.25 to 1.5 pF, 2000V	218206	72982	530-000	1	1	
C4	Not used						
C5	Cap, cer, 0.05 uF, +80/–20%, 25V	148924	72982	5855-Y5U-5032	1		
C6,C7	Cap, cer, 3.3 pF ±0.25 pF, 500V	272492	32897	301-000-C0J0-339C	2		
C8, C10	Cap, cer, 0.22 uF ±20%, 50V	309849	71590	CW30C224K	2		
C9,C11,	Cap, cer, 0.05 uF ±20%, 25V	148924	32897	5855Y5U503Z	2		
C16	Cap, elect , 10 uF, –10%, +50%, 25V	170266	73445	ET100X025A2	1		
CR1,CR2 CR4thru CR29, CR31 thru CR38	Diode, Si, 150 mA	203323	03508	1N4148	37	8	
CR39, CR40, CR41, CR42	Diode, Ge	149187	03877	1N270	4		
CR3	Diode, zener, 6.8V	260695	07910	1N754A	1	1	
J33	Connector, cozx, pcb mtg	352450	98291	51-051-0000	1		
K1, K2, K4 thru K9, K11, K13, K15thru K23, K26thru K30, K32, K33, K34	Relay, dry reed, SPST, 500 ohms ±10%, 10W	340364	20891	1300-4-1A	26		

Table 5-8. ATTENUATOR PCB ASSEMBLY, A6, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
K3, K10, K12, K14, K24, K25, K31	Relay, dry reed, DPST, 105 ohms, ±10%, 10W	340638	71482	MRB-2A05	7		
L1	Inductor, rf, 11 - turn, 10 MHz	357913	09969	LDH-1041-35	1		
L2	Inductor, 0.27 uh	313031	24759	MRD-27	1		
Q1,Q2	Xstr, Si, NPN	218396	04713	2N3904	2		
R1,R7	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	2		
R2, R17, R18	Res, comp, 4.3k ±5%, ¼W	193375	01121	CB4325	3		
R4	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	1		
R5, R6, R13, R14	Res, comp, 1k ±5%, ¼W	148023	01121	CB1025	4		
R8	Res, 98.876k ±0.01%, 1W	342808	89536	342808	1		
R9	Res, var, 50	267815	71540	190PC500B	1	1	
R10	Res, 1k ±0.01%, 0.3W	342774	18612	S102 type (order by description)	1		
R19	Res, comp, 100 ±5%, ¼W	147926	01121	CB1015	1		
R11, R12	Res, var, cermet, 5k ±10%, ½W	288282	71450	360S502	2	1	
R15, R16	Res, comp, 2.2k ±5%, ¼W	148049	01121	CB2225	2		
T1	Xfmr, low-frequency	342493	89536	342493	1		
T2	Xfmr, mid-frequency	402396	89536	402396	1		
T3	Xfmr, hi-frequency	342477	89536	342477	1		
U1, U9, U11	IC, TTL, hex inverter buffer/divider	288605	01295	SN7416P	3	1	

Table 5-8. ATTENUATOR PCB ASSEMBLY, A6, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U2, U4, U5, U17, U18	IC, TTL, dual peripheral pos NAND driver	329706	01295	SN75452P	5	1	
U3, U6, U7, U8	IC, TTL, quad 2-input, pos NAND buffer w/open collector output	310201	01295	SN7438N	4	1	
U10	IC, TTL, bcd-to-decimal decoders	293142	01295	SN7442N	1	1	
U12	IC, TTL, quad 2-input, NAND gates	292953	01295	SN7400N	1	1	
U13, U16	IC, TTL, hex inverter	292979	01295	SN7404N	2	1	
U14	IC, TTL, triple 3-input and NAND gates	292995	01295	SN7410N	1	1	
U15	IC, TTL, quad 2-input pos NAND buffers	296228	01295	SN7437N	1	1	
W1, W2	Cable assembly, output	405167	89536	405167	2		
W3	Cable assembly	338764	89536	338764	1		
W4	Wire assembly, shielded	356154	89536	356154	1		
1	Shield, attenuator	349399	89536	349399	1		
2	Spacer, ceramic	155473	71590	P-189	2		
3	Guide/retainer, orange	341099	89536	341099	6		
A6A1	Connector, Attenuator PCB Assembly	346577	89536	346577	1		
	(Not illustrated)						
	Connector, terminal	347831	71785	252-15-30-360	1		
	Connector, attenuator	346619	89536	346619	1		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A7	**PCB ASSEMBLY POWER AMPLIFIER (Figure 8-8)**	396713	89536	396713	REF		
C1, C22, C34	Cap, mica, 100 pF ±%, 500V	148494	53021	D15FD101J03	3		
C2	Cap, mica, 33 pF ±5%, 500V	160317	53021	D15ED330J03	1		
C3	Cap, Ta, 22 uF ±10%, 10V	236653	84411	JF-38	1		
C4 thru C8, C32	Cap, cer, 0.05 uF ±20%, 100V	149161	56289	55C23A1	6		
C9, C11, C13, C14, C27, C30, C31	Not used						
C10	Cap, plstc, 0.047 uF ±10%, 50V	271858	06001	75F1R5A473	1		
C12, C17, C19	Cap, Ta, 2.2 uF ±20%, 20V	161927	56289	196D225X0020	3		
C15, C16	Cap, cer, 0.05 uF +80/–10%, 500V	105676	56289	33C58	2		
C18	Cap, mica, 22 pF ±5%, 500V	148551	53021	D15ED220J03	1		
C20, C23	Cap, elect, 3 uF, 350V	340786	14655	Type 500D (Order by type and value)	2	1	
C21	Cap, plstc, 0.47 uF ±10%, 200V	271999	84411	X663FR47492	1		
C24	Cap, mica, 39 pF ±5%, 500V	148544	53021	D15ED390J03	1		
C25, C33	Cap, mica, 1,000 pF ±5%, 500V	148387	53021	D19FD101J03	2		
C26	Cap, plstc, 0.1 uF ±10%, 50V	271866	06001	75F2R5A104	1		
C28	Cap, polycarb, 0.33 uF ±10%, 50V	284703	84411	X463UW3349-50	1		
C29, C35	Cap, Ta, 330 pF ±10%, 6V	193011	56289	150D330X9006S2	2		
C36	Cap, mica 8 pF ±10%, 500V	216986	53021	D15CD080K03	1		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C37	Cap, mica, 220 pF ±5%, 500V	170423	53021	D15FD221J03	1		
C38, C39, C40	Cap, cer, 3,300 pF ±20%, 1kV	106674	56289	C023B102G332 M	3		
C41	Cap, cer, 300 pF ±10%, 500V	105734	71590	BB60301KW7W	1		
C42	Cap, cer, 500 pF ±10%, 1kV	105692	56289	C067B102E501 K	1		
C43	Cap, mica, 27 pF ±5%, 500V	177998	72136	DM15-270	1		
C44	Cap, cer, 0.05 uFd −20% +80%, 25V	148924	32897	5855Y5U503Z	1		
C45	Cap, cer, 0.1uF ± 20% 100V	149146	56289	33C41B6	1		
CR1, CR2, CR5, CR6, CR7, CR10, CR11, CR13, CR14, CR15, CR18, CR23, CR24, CR26, CR27	Diode, Si, 150 mA	203323	03508	1N4148	15	3	
CR3	Diode, zener, 125 mA, 7.5V ±5%	340687	12969	UZ8707	1	1	
CR4	Diode, zener, 130V, 1W	353284	12969	UZ8113	1	1	
CR8, CR9	Diode, zener, 95 mA, 10V ±5%	340695	12969	UZ8710	2	1	
CR12	Diode, zener, 6.8 mA 140V ±5%	340703	12969	UZ8114	1	1	
CR16, CR25	Not used						
CR17	Diode, Current Regulator 14 mA	340992	07910	U2605	1	1	
CR19, CR20	Diode, zener, 20V	291575	12969	UZ8726	2	1	
CR21	Diode, Si, 100 mA at 1.5V	348177	03508	DA2429	1	1	
CR22	Diode, Si, 1A, 600 piv	112383	05277	1N4822	1	1	

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR28, CR29	Diode, zener, 6.8V	260695	07910	1N754A	2		
CR30 thru CR33	Diode, Si, Rec, 1A	368738	04713	1N4004	4		
K1	Coil, U-6-P, reed relay	269019	71707	U-6-P	1		
	Switch, reed	284091	12617	MR138	1		
K2	Coil, U-6-P, reed relay	269019	71707	U-6-P	1		
L1 thru L9	Ferrite tube, choke core	321182	02114	56-590-65-4B	9		
L10	Inductor	379222	89536	379222	1		
Q1	Xstr, FET, N-channel	288324	15818	U2412E	1	1	
Q2 thru Q6, Q18	Xstr, Si, pnp	229898	04713	MPS6522	6	2	
Q7, Q8, Q34 thru Q37	Xstr, Si, npn	333898	04713	MPSH10	6	2	
Q9, Q30	Xstr, Si, pnp	266619	07263	2N4888	2	1	
Q10, Q16	Not used						
Q11, Q25, Q28, Q32	Xstr, Si, npn	342543	07263	SE7056	4	1	
	Heat Sink, radial (with Q25 & Q32)	104646	05820	NF207	2		
Q12, Q29, Q39	Xstr, Si, pnp	195974	04713	2N3906	3	1	
Q13, Q19, Q27, Q41	Xstr, Si, npn	218396	04713	2N3904	4		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q14, Q17	Xstr, Si, npn	218081	04713	MPS6520	2		
Q15	Xstr, Si, npn	342550	07256	MST40S	1		
	Heat sink w/mtg clamp	342857	91502	LP5B1	1		
Q20	Q20 Adapter Assembly	434480	89536	434480	1		
	Xstr, matched set, NPN	434456	89536	434456	1		
	Resistor, mf, 36.5 ±1%, 1/8W	168187	91637	MFF1-836R5F	4		
	Ferrite Bead	321182	02214	56-590-4B	1		
	PCB, xstr adapter	332312	89536	332312	1		
	Plate, xstr adapter	332023	89536	332023	1		
Q21	Xstr, Si, npn	340554	07263	2N3300	1		
	Heat sink, radial	104646	05820	NF207	1		
Q22	Xstr, Si, pnp	340497	07263	2N3502	1		
	Heat sink radial	104646	05820	NF207	1		
Q23	Q23 Adapter Assembly	332551	89536	332551	1		
	Xstr, matched set, PNP	419697	89536	419697	1		
	Resistor, mf, 36.5 ±1%, 1/8W	168187	91637	MFF1-836R5F	4		
	Ferrite Bead	321182	02114	56-590-65-4B	1		
	PCB, Xstr adapter	332312	89536	332312	1		
	Plate, xstr adapter	332023	89536	332023	1		
Q24, Q26	Xstr, Si, npn	313213	95303	2N5240	2		
Q31	Xstr, Si, npn	385302	04713	2N4240	1		
Q33, Q38	Xstr, FET, N-channel	261578	15818	V2366E	2		
Q40	Xstr, Si, NPN	179374	07263	2N2218	1		
Q42	Xstr, Si, NPN	335067	04713	2N3439	1		
R1	Res, met film, 3.32k ±0.1%, ½W	340760	91637	MFF1-23321/ 0.1%	1		
R2	Res, met film, 30.1k ±0.2%, 1W	340778	91637	MFF13012/0.1%	1		
R3	Res, met film, 1k ±0.1%, ½W	340752	91637	MFF1-21001/ 0.1%	1		
R4	Res, met film, 10k ±1%, 1/8W	168260	91637	MFF1-81002F	1		
R5	Res, comp, 4.7k ±5%, ½W	148072	01121	CB4725	1		
R6	Res, var, cermet, 100k ±20%, ½W	268581	71450	190PC104B	1		
R7	Res, met film, 20k ± 1%, 1/8W	291872	91637	MFF1-82002F	1		
R8	Res, met film, 464 ± 1%, 1/8W	271908	91637	MFF1-84640F	1		
R9	Res, met film, 221 ±1%, 1/8W	340794	91637	MFF1-82210F	1		
R10	Res, met film, 2.37k ±1%, ½W	182519	91637	MFF1-22371F	1		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R11, R12	Res, met film, 1.54k ±1%, 1/8W	289066	91637	MFF1-81541F	2		
R13, R14, R39	Res, met film 100 ±1%, 1/8W	168195	91637	MFF1-81000F	3		
R15, R43, R72, R85	Res, comp, 220 ±5%, ¼W	147959	01121	CB2215	4		
R16	Res, met film 17.4 ±1%, ½W	247270	91637	MFF1-21742F	1		
R17	Res, met film, 130k ±1%, ½W	247163	91637	MFF1-21303F	1		
R18	Res, met film, 29.4 ±1%, 1/8W	235135	91637	MFF1-82942F	1		
R19	Res, comp, 150k ±5%, ¼W	182212	01121	CB1545	1		
R20, R30, R73, R74, R75, R78, R80	Res, comp, 10k ±5%, ¼W	148106	01121	CB1035	7		
R21	Res, comp, 100k ±5%, ¼W	148189	01121	CB1045	1		
R22	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	1		
R23, R24, R31	Res, comp, 1k ±5%, ¼W	148023	01121	CB1125	3		
R25	Res, met film, 4.75 ±1%, 1/8W	260679	91637	MFF1-84751F	1		
R26	Res, var, cermet, 500 ±10%, 1W	291120	71450	3608501A	1		
R27	Res, met film, 1.74k ±1%, 1/8W	344358	91637	MFF1-81741F	1		
R28	Res, comp, 8.2 ±5%, ¼W	246751	01121	CB8R25	1		
R29, R41, R45, R65, R76	Not used						
R32	Res, met film, 147k ±1%, ½W	247205	91637	MFF1-21473F	1		
R33	Res, met film, 7.5k ±1%, 1/8W	223529	91637	MFF1-87501F	1		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R34, R35	Res, met film, 2.67k ±1%, 1/8W	289587	91637	MFF1-82671F	2		
R36	Res, pwr, ww, 18k ±10%, 5W	112839	56289	243E1835	1	1	
R37	Res, comp, 15 ±5%, ¼W	147876	01121	CB1505	1		
R38	Res, met film, 73.2k ±1%, ½W	247908	91637	MFF1-27322F	1		
R40, R46	Res, comp, 68k ±10%, 2W	110114	01121	HB6831	2		
R42, R44	Res, carbon comp, 2.2 ±5%, ¼W	354944	Toyo Elec-tronics	R-25/2.2Ω	2	1	
R47	Res, comp, 100k ±10%, 2W	158659	01121	HB1041	1		
R48	Res, met film, 165k ±1%, ½	247262	91637	MFF1-21653F	1		
R49, R53, R59	Res, met film, 15k ±1%, 1/8W	285296	91637	MFF1-81502F	3		
R50	Res, met film, 464 ±1%, 1/8W	340810	91637	MFF1-84640F	1		
R51, R89	Res, met film, 169k ±1%, ½W	176206	91637	MFF1-21693F	2		
R52, R79	Res, met film, 10 ±1%, 1/8W	268789	91637	MFF1-81005F	2		
R54	Res, comp, 6.8k ±5%, ¼W	148098	01121	CB6825	1		
R55	Res, met film, 191k ±1%, ½W	247353	91637	MFF1-21913F	1		
R56, R60	Res, comp, 68 ±5%, ¼W	147918	01121	CB6805	2		
R57	Res, comp, 1.2k ±5%, ¼W	190371	01121	CB1225	1		
R58	Res, met film, 30.1k ±1%, 1/8W	168286	91637	MFF1-83012F	1		
R61	Res, nickel film, 4.7 ±2%, 1/3W	342683	Toyo Elec-tronics	Type R-33/4.7Ω	1		
R62	Res, comp, 33k ±5%, ¼W	148155	01121	CB3335	1		
R63	Res, met film, 442 ±1%, 1/8W	340802	91637	MFF1-84220F	1		
R64, R71	Res, comp, 10 ±5%, ¼W	147868	01121	CB1005	2		

Table 5-9. POWER AMPLIFIER PCB ASSEMBLY, A7, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R66	Res, comp, 51, ±5%, ¼W	221879	01121	CB5105	1		
R67	Res, met film 1k ±1%, 1/8W	168229	91637	MFF1-81001F	1		
R68	Res, comp, 33, ±5%, ¼W	175034	01121	CB3305	1		
R69	Res, met film, 226 ±1%, 1/8W	325654	91637	MFF1-82260F	1		
R70	Res, comp, 330 ±5%, ¼W	147967	01121	CB3315	1		
R77, R86	Res, comp, 470 ±5%, ¼W	147983	01121	CB4715	2		
R81	Not used						
R82, R83, R84	Res, comp, 130 k ±5%, 2W	200527	01121	HB1345	3		
R87	Res, comp 2.7 ±5%, ¼W	246744	01121	CB2705	1		
R88	Res, met film, 174 ±1%, 1/8W	343913	91637	MFF1-81740J	1		
R90	Res, comp, 360 ±5%, ¼W	340844	01121	CB3615	1		
R91	Res, comp, 10M ±5%, ¼W	194944	01121	CB1065	1		
R92	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	1		
S1	Switch, slide, DPDT	234278	82389	XW1649	1	1	
U1	IC, selected	225961	89536	225961	1		
U2	IC, DTL, quad 2-input NAND power gate	288597	04713	MC858P	1	1	
XU2	Socket, IC, 14-contact	276527	23880	TSA-2900-14W	1		
1	Socket, xstr, T0-5 type	285262	71785	133-23-92-039	25		
	1 XQ2 thru XQ6, XQ9, XQ11, XQ12, XQ13, XQ18, XQ19, XQ21, XQ22, XQ25, XQ27 thru XQ30, XQ32, XQ33, XQ38 thru XQ42						
1	Guide, retainer, yellow	341107	89536	341107	6		
2	Shield, power amplifier	333633	89536	333633	1		
3	Socket single-pin	347765	89536	347765	10		
	Heat sink	396994	89536	396994	1		
	Heat sink, mtg. bracket	339648	89536	339648	6		
	Xstr pcb subassembly, power amplifier	396838	89536	396838	1		
	Insulator, xstr	396499	89536	396499	1		

Table 5-10. AC-DC CONVERTER PCB ASSEMBLY, A8

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A8	**PCB Assembly, AC-DC Converter (Figure 8-10)**	401059	89536	401059	REF		
A8A1, A8A2	DC Amplifier, PCB Sub-Assembly	332627	89536	1	2		
A8A3	Rectifier Output Circuit Assembly (See end of table)	- - - -	- - -	- - - -	-		
C1,C2	Cap, Ta, 2.2 uF, ±20%, 20V	161927	56289	196D225X0020	2		
C3, C45	Cap, mica, 100 pF, ±1%, 500V	226126	53021	D15FD101F03	2		
C4,C5	Cap, Ta, 220 uF, ±10%, 10V	182840	56289	150D227X901S2	2		
C6	Cap, mica, 1000 pF, ±5%, 500V	148387	53021	D19FD102J03	1		
C7, C29, C39	Cap, mica 33 pF, ±5%, 500V	160317	53021	D15ED330J03	3		
C8, C9, C14, C15, C24, C36, C40	Cap, cer, 0.01 uF, ±20%, 100V	149153	56289	C023B101F 103M	7		
C10	Cap, Ta, 68 uF, ±20%, 6V	160242	05397	K68P6	1		
C11, C18, C19	Cap, Ta, 10 uF, ±20%, 15V	193623	56289	196D106X0015	3		
C12	Cap, Ta, 1 uF, ±20%, 35V	161919	56289	196D105X0035	1		
C13	Cap, mylar, 0.001 uF, ±10%, 200V	159582	56289	192F10292	1		
C16,C21, C32 thru C35,C41, C42,C43	Not used						
C17	Cap, mica, 270 pF, ±5%, 500V	148452	53021	D15FD271J03	1		
1	Replacement must be made by ordering the complete PCB sub-assembly, FLUKE Stock No. Model No. and Serial No.						

Table 5-10. AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C20, C28, C30, C31	Cap, polyester, 0.022 uF, ± 10%, 250V	254484	73445	C280AE22K	4		
C22	Cap, mylar, 2 uF ±10%, 200V	106443	84411	TYPE X663F	1		
C23, C44, C48	Cap, Ta, 330 uF, ±10%, 6V	193011	56289	150D330X900 652	3		
C25	Cap, mylar, 2 uF ±20%, 100V	106963	84411	TYPE X663FR	1		
C26	Cap, plstc, 0.33 uF, ±10%, 200V	106047	72928	355C334K	1		
C27	Cap, mica, 68 pF, ±5%, 500V	148510	71236	LM15F680J	1		
C37, C38	Cap, Ta, 22 uF, ±10%, 15V	182816	56289	150D226X901 5A2	2		
C46	Cap, mica, 10 pF, ±10%, 500V	175216	53021	D15CD100K03	1		
C47	Cap, mica, 5 pF, ±10%, 500V	148577	53021	D15CD050K03	1		
CR1, CR2, CR6, CR8, CR13, CR14, CR17, CR18, CR19, CR20, CR21	Diode, Si, 150 mA	203323	03508	1N4148	11	2	
CR3	Diode, zener, 8.2V, 5%, 1W	355073	12969	UZ8708	1	1	
CR5	Diode, zener, 7.5V, 5%, 1W	340687	12969	UZ8707	1	1	
CR4	Diode, zener, 6.2V, ±5%	325811	07910	1N753A	1	1	
CR7, CR9	Diode, zener, 6.8V	260695	07910	1N754A	2	1	

Table 5-10. AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR10, CR11	Not used						
CR12	Diode, zener, 5.6V	277236	07910	1N752A	1	1	
CR15, CR16	Diode, zener	246611	07910	1N961B	2	1	
CR22, CR23	Diode, low cap, low leakage	348177	03508	DA2429	2	1	
CR24, CR25	Diode, zener 4.3V	180455	07910	1N749A	2	1	
K3	Relay, DPST, 105 ohms, 5V, 10W	340638	71482	MRB-2A05	1		
K1, K2, K4	Relay, SPST, 500 ohms, 10%, 10W	340364	71707	UF40062	3		
L1,L2, L3, L4	Ferrite tube	219535	02112	56-060-85-38	4		
Q1,Q8	Xstr, Si, pnp	225599	07263	S22650	2	1	
Q2	Xstr, Si, pnp	195974	04713	2N3906	1	1	
Q3,Q4	Xstr, FET, selected set	357863	89536	357863	1 set	1 set	
Q5,Q10 Q17, Q19, Q21, Q23, Q24	Xstr, Si, npn	218396	04713	2N3904	7	2	
Q6, Q14, Q15	Not used						
Q7	Xstr, Si, pnp	340471	07263	2N4917	1	1	
Q9	Xstr, N-channel, selected	363846	89536	363846	1	1	
Q11	Xstr, Si, pnp	343012	07263	2N4258	1	1	
Q12, Q13, Q16, Q18, Q20, Q22	Xstr, FET, N-channel	288324	15818	U2412E	6	2	

Table 5-10. AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R1	Res, met film, 22.6k, ±1%, 1/8W	288431	91637	MFF1-82262F	1		
R2	Res, met film, 43.2, ±1%, 1/8W	296731	91637	MFF1-843G2F	1		
R3,R4, R34	Res, met film, 1k, ±1%, 1/8W	168229	91637	MFF1-81001F	3		
R5,R43 thru R46, R48, R50, R51, R54, R57, R87, R88	Res, comp, 1M, ±5%, ¼W	182204	01121	CB1055	12		
R6,R9	Res, comp, 100, ±5%, ¼W	147926	01121	CB1015	2		
R7	Res, comp, 2.7k, ±5%, ¼W	170720	01121	CB2725	1		
R8,R23	Res, comp, 20, ±5%, ¼W	246728	01121	CB2005	2		
R10, R24	Res, comp, 510, ±5%, ¼W	218032	01121	CB5105	2		
R11	Res, comp, 16k, ±5%, ¼W	221606	01121	CB1635	1		
R12	Res, met film, 1.1k, ±1%, 1/8W	241497	91637	MFF1-81101F	1		
R13	Res, comp, 120k, ±5%, ¼W	193458	01121	CB1245	1		
R14, R25	Res, met film, 10k, ±1%, 1/8W	168260	91637	MFF1-81002F	2		
R15, R16, R21,	Res, comp, 5.1k, ±5%, ¼W	193342	01121	CB5125	3		
R17, R38	Res, comp, 10k, ±5%, ¼W	148106	01121	CB1035	2		
R18, R84	Res, comp, 15k, ±5%, ¼W	148114	01121	CB1535	2		
R19	Res, comp, 30k, ±5%, ¼W	193417	01121	CB3035	1		

Table 5-10. AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R20	Res, comp, 33k, ±5%, ¼W	148155	01121	CB3335	1		
R22	Res, comp, 22, ±5%, ¼W	147884	01121	CB2205	1		
R26, R27, R61	Res,met film, 1M, ±1%, 1/8W	278797	91637	MFF1-81MEGF	3		
R28	Res, met film, 332, ±1%, 1/8W	192898	91637	MFF1-83320F	1		
R29, R63	Res, var, cermet, 100k, ±20%, ½W	268581	71450	190DC104B	2	1	
R30, R31, R32	Res, met film, 1k, ±0.01%, 0.3W	342774	18612	S102 type (order by) description	3		
R33	Res, met film, 1.21k, ±1%, 1/8W	229146	91637	MFF1-81811F	1		
R35	Res, met film, 35.885k, ±0.01%, 0.3W	342790	18612	S102 type (order by description)	1		
R36	Res, met film, 12k, ±0.25%, 1/8W	267658	91637	MFF1-81202F	1		
R37	Res, met film, 6.002k, ±0.01%, 0.3W	342782	89536	342782	1		
R39 thru R42, R65, R66	Res, comp, 100k, ±5%, ¼W	148189	01121	CB1045	6		
R47	Res, comp, 2M, ±5%, ¼W	268771	01121	CB2055	1		
R49, R52, R55, R58	Res, comp, 10, ±5%, ¼W	147868	01121	CB1005	4		
R53	Res, comp, 510k, ±5%, ¼W	275685	01121	CB5145	1		
R56	Res, comp, 240k, ±5%, ¼W	218016	01121	CB2445	1		
	Special value: Must be ordered by Fluke Stock number						

Table 5-10, AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R59	Res, met film, 243k, ±1%, 1/8W	235242	91637	MFF1-82433F	1		
R60	Res, met film, 3.83k, ±1%, 1/8W	235143	91637	MFF1-83831F	1		
R62	Res, met film, 215, ±1%, 1/8W	343533	91637	MFF1-82150F	1		
R64, R68, R70 thru R74, R76, thru R80, R82	Not used						
R67, R75	Res, comp, 75k, ±5%, ¼W	220525	01121	CB7535	2		
R69	Res, comp, 22k, ±5%, ¼W	148130	01121	CB2235	1		
R81	Res, met film, 226, ±1%, 1/8W	325654	91637	MFF1-82260F	1		
R83	Res, comp, 680, ±5%, ½W	178392	01121	EB6815	1		
R85	Res, met film, 4.42k, ±1%, 1/8W	288514	91637	MFF1-84421F	1		
R86	Res, met film, 2k, ±1%, 1/8W	235226	91637	MFF1-82001F	1		
R89	Res, var, cermet, 1k, ±20%, 0.5W	267856	71450	190PC102B	1	1	
R90	Res, comp, 6.2k,±5%,¼W	221911	01121	CB6225	1		
R91	Res, var, cermet, 100, ±20%, ½W	267823	71450	190PC101B	1	1	
R92, R93	Res, comp, 1.2k ±5%, ¼W	190371	01121	CB1225	2		
U1	IC, operational amplifier	329912	27014	LM318H	1	1	
U2, U4	IC, operational amplifier	271502	12040	LM301A	2	1	
	Guide/ retainer, green	341115	89536	341115	6		
	Connector post	267633	00779	86144-1	12		
	Connector, rf	352450	98291	51-051-0000	2		
	Socket, xstr	285262	71785	133-23-92-039	3		

Table 5-10, AC-DC CONVERTER PCB ASSEMBLY, A8 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	Cover, dc amplifier	341529	89536	341529	2		
A8A3	Rectifier Output Assembly	406959	89536	406959	1		
CR10, CR11	Diode, hi-speed switching	408815	28480	5082-6265	2	1	
Q14	Xstr, Si, pnp	343012	07263	2N4258	1	1	
Q15	Xstr, Si, npn	248351	04713	MPS918	1	1	
Q25	Xstr, FET, N-Channel	288324	15818	U2412E	1	1	
	NOTE! *It is recommended that the A8A3 assembly, PN406959, be replaced as a unit, However, individual components may be changed if necessary. Care should be taken to position the new or repaired assembly in the same manner on the pcb as the assembly removed.*						

Table 5-11. OSCILLATOR CONTROL PCB ASSEMBLY, A9

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A9	**PCB Assembly, Oscillator Control (Figure 8-12)**	396705	89536	396705	REF		
C1,C2, C5,C29, C34	Cap, Ta, 10 uF, ±20%, 15V	193623	56289	196D106X0015	5		
C3,C68	Cap, mica, 1,000 pF, ±5%, 500V	148387	72136	DM19F102J	2		
C4,C9	Cap, mica, 100 pF, ±5%, 500V	148494	72136	DM15F221J	2		
C6, C12 C30,C33	Cap, cer, 10 pF, 3 kV	105536	56289	19C312	4		
C7,C10	Cap, tant, 10 uF, ±20%, 20V	330662	56289	196D106X0020 JA1	2		
C8	Cap,mica, 30 pF, ±5%, 500V	340570	72136	DM15E300J	1		
C11, C17, C20, C23, C48 thru C53, C57 C58, C61, C62, C65, C72, C73	Not used						
C13, C86, C87	Cap, Ta, 6.8 uF, ±10%, 35V	182782	56289	150D685X903 3B2	3		
C14, C15, C45, C46, C75, C84	Cap, cer, 0.01 uF, ±20%, 100V	149153	56289	C023B101F10 3M	6		

Table 5-11. OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C16, C41, C42, C74, C82, C83	Cap, Ta, 22 uF, ±10%, 15V	182816	56289	150D226X9015A2	6		
C18, C19	Cap, plstc, 1.5 uF, ±5%, 50V	343624	84411	Type X463UW (Include values when ordering)	2		
C21, C22	Cap, plstc, 0.15 uF, ±5%, 50V	343616	84411	Type X463UW (Include values when ordering)	2		
C24, C25	Cap, cerm, 0.013 uF, ±10%	284893	84411	13351	2		
C26	Cap, plstc, 0.01 uF, ±10%, 50V	309906	06001	75F1R5A100	1		
C27, C28, C47, C70, C71	Cap, Ta, 1 uF, ±20%, 35V	161919	56289	196D105X0035	5		
C31	Cap, cerm, 82 pF, ±10%, 500V	105585	72982	DD820	1		
C32	Cap, cerm, 500 pF, ±10%, 1 kV/2250	105692	71590	2DDH60N501K	1		
C35	Cap, mica, 15 pF, 15%, 500V	148569	53021	D15ED150J03	1		
C36	Cap, mica, 33 pF, ±5%, 500V	160317	53021	D15FD330J03	1		
C37, C77	Cap, mica, 2,000 pF , ±5%, 500V	321158	53021	D19FD202J03	2		
C38, C78	Cap, polyester, 0.022 pF ±10%, 250V	234484	25403	C280AE22K	2		
C39, C79	Cap, plstc, 0.22 pF, ±10%, 250V	194803	25403	C280MAE/A220K	2		
C40, C80, C81, C85	Cap, Ta, 4.7 uF, ±20%, 20V	161943	56289	196D475X0020	4		
C43	Cap, mica, 200 pF, ±5%, 500V	272880	53021	D15FD201J03	1		

Table 5-11, OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C44	Cap, cerm, 3.3 pF, 1 kV	105577	72982	DD3R3	1		
C54	Cap, Piston Trimmer	174912	73899	VCJ1677B	1		
C55	Cap, mica, 10pF, ±10%, 500V	175216	71236	DM15C0100K	1		
C56	Cap, mica, 330 pF, ±5%, 500V	148445	53021	D15FD331J03	1		
C59, C60	Cap, mylar, 0.1 uF ±10%, 250V	393439	25403	C280MAH/A100K	2		
C63	Cap, mylar, 0.047 uF, ±10%, 250V	162008	25403	C280MAE/A47K	1		
C64	Cap, mylar, 0.33uF, ±10%, 50V	284703	84411	X463UW3349.50	1		
C66	Cap, plstc, .068 uF, 10%, 100V	288886	84411	X463UW6891W	1		
C67	Cap, mylar, 0.01 uF ±10%, 250V	402818	25403	C280MAF/A10K	1		
C69	Cap, met poly, 0.015 uF, ±5%, 100V	310482	74411	X463UW15051	1		
C76	Cap, Ta, 39 uF, ±20%, 6V	163915	56289	196D396X0006	1		
C88	Cap, Ta, 2.2 uF, ±20%, 20V	161927	56289	196D225X0020-HA1	1		
CR1, CR2, CR5, CR7, CR13, CR14, CR16, thru CR19, CR22, CR24, CR26 thru CR30, CR32, CR35, CR36, CR37, CR42, CR43, CR44, CR56, thru CR51, CR56, CR57, CR59 thru CR68, CR73 thru CR78	Diode, Si, 150 mA	203323	07263	1N414B	48	10	

Table 5-11, OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR3, CR6, CR8, CR31, CR33, CR45	Diode, zener, 4.3V	180455	07910	1N749A	6	2	
CR4, CR15, CR34	Diode, zener, 5.6V	277236	07910	1N752A	3	1	
CR9 thru CR12 CR38, CR39	Diode, Si, 100 mA at 1.5V	348177	03508	DA2429	6	1	
CR20, CR21	Diode, 2ma	284927	07910	TCR5305	2	1	
CR23, CR25, CR52 thru CR55, CR58, CR71	Not used						
CR40, CR41	Diode, zener, 18V, ±5%	327973	07910	1N967B	2	1	
CR69, CR70	Diode, zener, 20V	180463	07910	1N968B	2	1	
J61, J62, J63	Connector, coax, pcb mtg.	352450	98291	51-051-0000	3		
K1, K2, K3	Relay, dry reed	341024	71482	MRB-2A15	3		
K4	Not used						
K5	Relay, dry reed	352658	20891	1300-12-1A	1		
L1	Core, ferrite	219535	89536	219535	1		
L2,L3	Choke, 6-turn	320911	89536	320911	2		

Table 5-11, OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
L4,L5, L6	Ferrite bead (to Q8, Q18 and Q27)	321182	02114	56-590-56-4B	3		
Q1,Q17	Xstr, FET matched set (Red dot Q1, Yellow dot Q17)	337774	89536	337774	1 set	1 set	
Q2, Q10, Q12, Q14, Q15, Q16, Q19, Q24, Q25, Q26	Xstr, Si, pnp	195974	04713	2N3906	10	2	
Q3, Q8, Q9, Q11, Q18, Q27, Q33	Xstr, Si, npn	218396	04713	2N3904	7	2	
Q4, Q29, Q30, Q31	Xstr, FET, N-channel	261578	15818	U1897E	4	1	
Q5, Q6	Xstr, matched set	357863	89536	357863	1 set	1 set	
Q7	Xstr, Si, pnp	340471	07263	2N4917	1	1	
Q13, Q28	Not used						
Q20, thru Q23	Xstr, FET, N-channel	288324	15818	U2412E	4	1	
Q32	Xstr, FET, N-channel	288324	21845	F2629	1	1	
R1, R12, R17, R19, R58, R59	Res, comp, 5.1k, ±5%, ¼W	193342	01121	CB5125	6		

Table 5-11, OSCILLATOR CONTROLPPCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R2, R61, R67, R82, R115 thru R118 R122	Res, comp, 10k, ±5%, ¼W	148106	01121	CB1035	9		
R3	Res, comp, 510, ±5%, ¼W	218032	01121	CB5115	1		
R4, R22, R24, R54	Res, comp, 1.5k, ±5%, ¼W	148031	01121	CB1525	4		
R5, R7, R8, R18, R25, R30, R70	Res, comp, 3.6k, ±5%, ¼W	241620	01121	CB3625	7		
R6	Res, comp, 27k, ±5%, ¼W	148148	01121	CB2735	1		
R9, R51	Res, comp, 560, ±5%, ½W	109124	01121	EB5615	2		
R10, R20, R102	Res, comp, 18k, ±5%, ¼W	148122	01121	CB1835	3		
R11, R71	Res, comp, 33, ±5%, ¼W	175034	01121	CB3305	2		
R13, R98, R99, R100	Res, comp, 1M, ±5%, ¼W	182204	01121	CB1055	4		
R14	Res, comp, 68, ±5%, ¼W	147918	01121	CB6805	1		
R15	Res, comp, 3.9k, ±5%, ¼W	148064	01121	CB3925	1		
R16, R55, R69	Res, comp, 4.7k, ±5%, ¼W	148072	01121	CB4725	3		

Table 5-11, OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R21, R53, R89, R92, R93	Res, comp, 1k, ±5%, ¼W	148023	01121	CB1025	5		
R23, R27, R28	Res, comp, 750, ±5%, ¼W	218024	01121	CB7515	3		
R26, R29	Res, comp, 360, ±5%, ¼W	340844	01121	CB3615	2		
R31	Res, var, cermet, 20k, ±10%, ½W	291609	71450	360S-203A	1	1	
R32, R56, R57	Res, comp, 6.8k, ±5%, ¼W	148098	01121	CB6825	3		
R33	Res, comp, 15k, ±5%, ¼W	148114	01121	CB1535	1		
R34, R40, R43, R46, R49, R66	Res, comp, 16k, ±5%, ¼W	221606	01121	CB1635	6		
R35	Res, comp, 8.2k, ±5%, ¼W	160796	01121	CB8225	1		
R36, R37, R38, R60, R64, R76, R83 R94, R95, R96, R108	Not used						
R39, R42, R45, R48	Res, comp, 82k, ±5%, ¼W	188458	01121	CB8235	4		

Table 5-11. OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R41, R44, R47, R50, R65, R114 R123	Res, comp, 51k, ±5%, ¼W	193334	01121	CB5135	7		
R52, R109	Res, var, cermet, 50k, ±10%	288290	71450	360S-503A	2	1	
R62	Res, comp, 5.6k, ±5%, ¼W	148080	01121	CB5625	1		
R63, R81	Res, comp, 20k, ±5%, ¼W	221614	01121	CB2035	2		
R68	Res, comp, 24k, ±5%, ¼W	193425	01121	CB2435	1		
R72 thru R75	Res, comp, 510k, ±5%, ¼W	275685	01121	CB5145	4		
R77, R78	Res, met film, 1.5k, ±1%,	313098	91637	MFF1-81501F	2		
R79, R80	Res, met film, 15.0k, ±1%, 1/8W	285296	91637	MFF1-81502F	2		
R84, R85	Res, comp, 470, ±5%, ¼W	147983	01121	CB4715	2		
R86	Res, met film, 10k, ±1%, 1/8W	168260	91637	MFF1-81002F	1		
R87	Res, comp, 3k, ±5%, ¼W	193508	01121	CB3025	1		
R88	Res, met film 30.1k, ±1%, 1/8W	168286	91637	MFF1-83012F	1		
R90, R91	Res, met film, 26.7k, ±1%, 1/8W	245779	91637	MFF1-82672F	2		
R97	Res, met film, 28k, ±1%, 1/8W	291385	91637	MFF1-82802F	1		
R101	Res, comp, 13k, ±5%, ¼W	221598	01121	CB1335	1		
R103	Res, met film, 31.6k, ±1%, 1/8W	261610	91637	MFF1-83162F	1		

Table 5-11. OSCILLATOR CONTROL PCB ASSEMBLY, A9 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R104, R105	Res, comp, 620, ±5%, ½W	108704	01121	EB6215	2		
R106, R107	Res, comp, 20, ±5%, ¼W	246728	01121	CB2005	2		
R110	Res, var, cermet, 100k, ±10%, 1W	288308	71450	360S-104A	1	1	
R111	Res, met film, 18.2k, ±1%, 1/8W	236810	91637	MFF1-81822F	1		
R112	Res, met film, 36.5k, ±1%, 1/8W	235309	91637	MFF1-83652F	1		
R113	Res, comp, 3.3k, ±5%, ¼W	148056	01121	CB3325	1		
R119, R120, R121	Res, met film, 12.1k, ±1%, 1/8W	234997	91637	MFF1-81212F	3		
U1,U7	IC, linear, hi-speed, diff comparator	343343	07263	UA710	2	1	
U2, U11, U15	IC, TTL, dual retriggerable one shot	310235	01295	SN74123N	3	1	
U3,U9	IC, linear, 4-quad multiplier	343335	04713	Mc1494L	2	1	
U4	IC, TTL, quad 2-input NAND gate	292953	07263	SN7400	1	1	
U5	IC, TTL, decoder-driver	293175	01295	SN74145	1	1	
U6	IC, TTL, phase-freq. detector	320721	04713	MC4044F	1	1	
U8	IC, Op-amp, TO-78	271502	12040	LM301A	1	1	
U10	IC, linear, dual-volt tracking regulator	339770	34333	SG35010	1	1	
U12	IC, DCL, MSI, 4-bit digital comparator	293258	04713	MC8242P	1	1	
U13	IC, TTL, triple 3-input pos NAND gate	292995	07293	SN7410	1	1	
U14	IC, linear, op-amp	329912	27014	LM318H	1	1	
	Guide retainer, blue	341123	89536	341123	6		
	Socket, IC, 14-contact	276527	23880	TSA-2900-16W	1		
	Socket, IC, 16-contact	276535	23880	TSA-2900-16W	2		
	Socket, xstr, TO-5	285262	71785	133-23-92-039	2		
	Terminal, pin connector	267500	00779	86144-2	4		

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A10	**PCB Assembly, Oscillator (Figure 8-14)**	396697	89536	396697	REF		
C1 thru C4, C11, C22, C32	Cap, Ta, 1 uF, ±20%, 35V	161919	56289	196D105X0035	7		
C5	Cap, mica, 15 pF, ±5%, 500V	148569	72136	DM15150	1		
C6, C10, C20, C21, C30, C31, C38, C43, C61, C62	Not Used						
C7, C18, C27	Cap, mica, 680 pF, ±5%, 500V	148403	84171	MF19F101F	3		
C8, C16, C26	Cap,mica, 33 pF, ±5%, 500V	160317	53021	D15ED330J03	3		
C9, C17, C28	Cap, cer, 300 pF, ±10%, 500V	105734	71590	BB60301KW7W	3	1	
C12, C14, C15, C24, C25, C33	Cap, Cer, 0.025 uF, ±20%, 100V	168435	56289	C023B1014253M	6	1	
C13, C23, C34	Cap, Ta, 15 uF, ±20%, 6V	161935	56289	196D156X0006	3		
C19, C29	Cap, mica, 22 pF, ±5%, 500V	148551	53021	D15ED220J03	2		
C35, C36, C37	Cap, cer, 0.01 uF, ±20%, 100V	149153	56289	C023B101F103M	3	1	

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C39, C44	Cap, mica, 1300 pF, ±5%, 500V	182881	530211	D19FD132J03	2		
C40, C46	Cap, mica, 130 pF, 1%, 200V	368803	53021	D15FD131F03	2		
C41, C42, C45	Cap, piston trimmer	174912	73899	VCJ1677B	3		
C47, C51	Cap, mica, 4 pF, ±0.5 pF, 500V	190397	53021	D15CD040D03	2		
C48, C52	Cap, mica, 8 pF, ±10%, 500V	216986	53021	D15CD080K03	2		
C49, C53, C71	Cap, mica, 10 pF, ±10%, 500V	175216	53021	D15CD100K03	3		
C50, C54, C55, C58	Cap, mica, 1 pF, ±0.5 pF, 500V	175208	53021	D15CD020D03	4		
C56, C59	Cap, cer, 1 pF, ±0.25 pF, 500V	105908	72982	331-000/C0K0/ 109C	2	1	
C57, C60	Cap, cer, 0.5 pF, ±0.25 pF, 500V	174896	71590	Type TC2 (order by description)	2 2	1 1	
C63, thru C70	Cap, cer, 0.22 uF, ±20%, 50V	309849	71590	CW30C224K	8		
C72, C73	Cap, elect, 470 pF, 10% +100%, 25V	168153	73445	ET471X-25A01	2	1	
CR1, CR2, CR4, CR7, CR8, CR9, CR13, CR14, CR16, CR21	Not used						

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10 (Cont'd)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
CR3, CR10, CR15, CR19, CR20, CR22 thru CR25	Diode, Si, 150 mA	203323	07263	1N4148	9	2	
CR5, CR6, CR11, CR12, CR17, CR18, CR26, CR27	Diode, zener, 6.8V	260695	07910	1N754	8	2	
K1	Switch, reed relay	219097	15898	765972	1		
	Coil, reed relay	229971	71707	UD-12-P	1		
L1, L2	Choke, 6-turn	320911	89536	320911	2		
Q1, Q2, Q3, Q5 thru Q17	Zstr, Si, npn	218396	04713	2N3904	16	4	
Q4, Q54, Q62, Q70	Not used						
Q18, Q20 thru Q24, Q34, Q36 thru Q40	Xstr, FET, N-channel	261578	07910	U1897E	12	3	
Q19, Q35	Xstr, FET	428169	07910	U2366E	2	1	
Q25 thru Q33, Q41 thru Q51, Q58, Q59, Q66, Q67	Xstr, FET, N-Channel	288324	15818	U2412E	24	5	

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
Q52, Q53, Q60, Q61, Q68, Q69	Xstr, si, pnp	340471	07263	2N4917	6	2	
Q54, Q62, Q70	Xstr, Si, NPN	333898	04713	MPSH10	3		
Q55, Q63, Q71	Xstr, Si, npn	168716	12040	SM07154	3	1	
Q56, Q64, Q72	Xstr, Si, npn	340554	07263	2N3300	3	1	
Q57, Q65, Q73	Xstr, Si, pnp	340497	07263	2N3502	3	1	
R1, R4	Res, met film, 1k, ±1%, 1/8W	340380	91637	MFF1-81001F	2		
R2	Res, var, cermet, 100k, ±10%, 1W	288308	71450	360S-104A	1	1	
R3	Res, comp, 47M, ±10%, ½W	146415	01121	EB4761	1		
R5, R159	Res, comp, 27 ±5%, ¼W	160812	01121	CB2705	2		
R6,R7, R160, R161	Res, comp, 36 ±5%, ¼W	312843	01121	CB3605	4		
R8, R162	Res, comp, 15, ±5%, ¼W	147876	01121	CB1505	2		
R9, R10, R11, R31, R84, R87, R88, R90, R91, R92, R95, R123, R143 thru R146, R150, R158, R191	Not used						

Table 5-12. OSCILLATOR PCB ASSEMBLY, A10 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R12, R61	Res, met film, 4.93 k, ±1%, 1/8W	340406	91637	MFF1-84931F	2		
R13, R14, R62, R63	Res, met film, 2.43k, ±1%, 1/8	306977	91637	MFF1-82431F	4		
R15, R64	Res, met film, 9.93k, ±1%, 1/8W	340398	91637	MFF1-89931F	2		
R16, R65	Res, met film, 12.4k, ±1%, 1/8W	261644	91637	MFF1-81242F	2		
R17, R21, R66, R70, R164, R178	Res, met film, 14.9k, ±1%, 1/8W	291369	91637	MFF1-82492F	6		
R18, R22, R23, R67, R71, R72, R166, R168, R180, R182	Res, met film, 49.9k, ±1%, 1/8W	268821	91637	MFF1-84992F	10		
R19, R68	Res, met film, 100k, ±1%, 1/8W	248807	91637	MFF1-81003F	2		
R20, R69	Res, met film, 124k, ±1%, 1/8W	288407	91637	MFF1-81243F	2		
R24,R28 R29,R30, R32 thru R36,R73, R170, R184	Res, comp, 62k, ±5%, ¼W	220053	01121	CB6235	12		
R25, R74, R172, R186	Res, comp, 47k, ±5%, ¼W	148163	01121	CB4735	4		
R26, R75, R174, R188	Res, comp, 51k, ±5%, ¼W	193334	01121	CB5235	4		

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R27, R50 thru R60, R76, R176, R190	Res, comp, 100k, ±5%, ¼W	148189	01121	CB1045	15		
R37 thru R44	Res, comp, 200k, ±5%, ¼W	248781	01121	CB2045	8		
R45 thru R48, R103, R130, R157	Res, comp, 15k, ±5%, ¼W	148114	01121	CB1535	7		
R49, R193, R195	Res, comp, 30k, ±5%, ¼W	193417	01121	CB3035	3		
R77, R85, R105, R113, R135, R140	Res, comp, 100k, ±5%, ¼W	147926	01121	CB1045	6		
R78, R79	Res, comp, 51, ±5%, ¼W	221879	01121	CB5105	2		
R80, R108, R138	Res, comp, 2.4k, ±5%, ¼W	193433	01121	CB2425	3		
R81, R82, R109, R131, R132, R133	Res, comp, 20k, ±5%, ¼W	221614	01121	CB2035	6		
R83, R86, R110 R112, R134 R142	Res, comp, 10k, ±5%, ¼W	148106	01121	CB1035	6		
R89, R116, R141	Res, comp, 5.6K, ±5%, ¼W	148080	01121	CB5625	3		
R93, R120, R147	Res, comp, 2.7, ±5%, ¼W	246744	01121	CB2705	3		

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R94, R96, R122, R124, R149, R151	Res, comp, 13k, ±5%, ¼W	221598	01121	CB1335	6		
R97, R121, R148	Res, comp, 1.5k, ±5%, ¼W	148031	01121	CB1525	3		
R98, R125, R152	Res, comp, 200, ±5%, ¼W	147959	01121	CB2215	3		
R99, R126, R153	Res, comp, 8.2k, ±5%, ¼W	160796	01121	CBB225	3		
R100, R127, R154	Res, comp, 4.3k, ±5%, ¼W	193375	01121	CB4325	3		
R101, R102, R104, R111, R128, R129, R139, R155, R156	Res, comp, 20, ±5%, ¼W	246728	01121	CB2005	9		
R106, R107, R136, R137	Res, comp, 270, ±5%, ¼W	160804	01121	CB2715	4		
R163, R177	Res, met film, 3.09k, ±1%, 1/8W	235150	91637	MFF1=83091F	2		
R165, R179	Res, met film, 6.19k, ±1%, 1/8W	283911	91637	MFF1-86191F	2		
R167, R181	Res, met film, 2.8k, ±1%, 1/8W	325670	91637	MFF1-82801F	2		
R169, R183	Res, comp, 3.3k, ±5%, ¼W	148056	01121	CB3325	2		
R171, R175, R185, R189	Res, comp, 1k, ±5%, ¼W	148023	01121	CB1025	4		
R173, R187	Res, comp, 510, ±5%, ¼W	218032	01121	CB5115	2		

Table 5-12, OSCILLATOR PCB ASSEMBLY, A10 (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R191	Res, comp, 680, ±5%, ¼W	148007	01121	CB6815	1		
R192, R194	Res, comp, 330, ±5%, ¼W	147967	01121	CB3315	2		
R196 thru R210	Res, comp, 27k ±5%, ¼W	148148	01121	CB2735	15		
U1, U2, U3	IC, operational amplifier	271502	12040	LM301A	3		
1	Conn, receptable, PCB	284281	00779	380598-2	4		
2	Guide/retainer, violet	341131	89536	341131			
	Xstr, spacer	152207	07047	10123-DAP	6		

Table 5-13. REFERENCE PCB ASSEMBLY, A12

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A12	**PCB Assembly Reference (Figure 8-18)**	332650	89536	332650	REF		
C1,C4	Cap, cer, 0.002uF ±10%, 500V	106732	71590	CF122	2		
C2,C8, C10, C34	Cap, Fxd, cer, 0.01uF ±20%, 100V	149153	56289	C023B101F103 M	4		
C3	Cap, mica, 220 pF ±5%, 500V	170423	14655	CD15F221J	1		
C5	Cap, cer, 0.1uF ±20%, 100V	149146	56289	33C41B6	1		
C6	Cap, mica, 3900 pF ±5%, 500V	160325	14655	CD19F392J	1		
C7	Cap, mica, 30 pF ±5%, 500V	340570	53021	D155E300JP	1		
C9	Cap, mica, 56 pF ±5%, 500V	148528	14655	CD15F560J	1		
C11, C12, C14, C17, C26	Cap, mica, 33 pF ±5%, 500V	160317	72136	DM-15-330	5		
C13, C15, C16, C18, C19	Cap, fxd, poly., 1.25 uF 10%, 100V	340562	84411	X463UW1.25--91W	5		
C20 thru C25, C28 thru C31	Cap, cer, 0.025 uF ±20%, 100V	168435	56289	C023B101H253 M	10		
C27	Cap, Ta, 10 uF ±20%, 15V	193623	56289	196D106X0015	1		
C32, C33, C37 thru C40	Cap, Ta, 4.7 uF ±20%, 20V	161943	57289	196D475X0020	6		
C35	Cap, mica, 10 pF ±10%, 500V	175216	14655	CD15C0100K	1		
C36	Cap, Ta, 0.47 uF ±20%, 35V	161349	56289	196D474X0035 HA1	1		
C41	Cap, Ta, 39 uF ±20%, 6V	163915	56289	196D396X006 JA1	1		

Table 5-13. REFERENCE PCB ASSEMBLY, A12, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
C42, C43	Cap, cer., 0.22 uF ±20%, 50V	309849	71590	CW30C224K	2		
CR1, CR2, CR3	Diode, si, 150 mA	203323	07263	1N4148	3		
CR4	Diode, Zener, 5.6V	277236	07910	1N752A	1		
L1 thru L7	Inductor, 6-turn bead	320911	89536	320911	7		
Q1,Q2, Q14	Xstr, si, PNP	229898	04713	MPS6522	3		
Q3,Q4, Q5, Q12, Q13	Xstr, si, NPN	248351	04713	MPS918	5		
Q6	Xstr, si, PNP	266290	04713	MPS3640	1		
Q7	Xstr, si, NPN	340554	07263	2N3300	1		
Q8,Q10	Xstr, si, NPN	218396	04713	2N3904	2		
Q9,Q11	Xstr, FET, N-channel	261578	15818	U1897E	2		
R1,R73	Res, comp, 3.9k ±5%, ¼W	148064	01121	CB3925	2		
R2,R4, R57	Res, comp, 470 ±5%, ¼W	147983	01121	CB4715	3		
R3, R52, R54, R55	Res, comp, 1k ±5%, ¼W	148023	01121	CB1125	4		
R5,R6, R11	Res, comp, 270 ±5%, ¼W	160804	01121	CB2715	3		
R7	Res comp, 100 ±5%, ¼W	147926	01121	CB1015	1		
R8,R50	Res, comp, 1.8k ±5%, ¼W	175042	01121	CB1825	2		
R9	Res, comp, 68 ±5%, ¼W	147918	01121	CB6805	1		
R10	Res, comp, 2.7k ±5%, ¼W	170720	01121	CB2725	1		
R12	Res, comp, 1.5k ±5%, ¼W	148031	01121	CB1525	1		
R13 thru R32 R77	Res, comp, 2.2k ±5%, ¼W	148049	01121	CB2225	21		

Table 5-13. REFERENCE PCB ASSEMBLY, A12, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R33 thru R36	Res, comp, 330 ±5%, ¼W	147967	01121	CB3315	4		
R37, R38	Res, comp, 62 ±5%, ¼W	261842	01121	CB6205	2		
R39, R40	Res, met flm, 20k .01% 1/8W	340620	03888	Type T9	2		
R41, R42, R46, R49	Res, Ref Amp Set	1	89536	338970	1		
R43	Res, comp, 82 ±5%, ¼W	149484	01121	CB8205	1		
R44	Res, met flm, 17.4k .1% 1/8W	340612	03888	Type T9	1		
R45	Res, ww, 86.75	339531	89536	339531	1		
R46	Not used						
R47	Res, met flm, 3.74k ±1%, 1/8W	272096	91637	Type MFF 1/8	1		
R48	Res, var, cermet 20 ±20%, ½W	261180	12237	T90PC200B	1		
R49	Not used						
R51	Res, comp, 22k ±5%, ¼W	148130	01121	CB2235	1		
R53	Res, comp, 12k ±5%, ¼W	159731	01121	CB1235	1		
R56	Res, comp, 24k ±5%, ¼W	193425	01121	CB2435	1		
R58	Res, met flm, 28.0k 1% 1/8W	291385	91637	Type MFF1/8	1		
R59	Res, met flm, 5.76k 1% 1/8W	260349	91637	Type MFF1/8	1		
R60	Res, met flm, 7.15k ±1% 1/8W	260356	91637	Type MFF1/8	1		
R61	Res, met flm, 3.65k ±1% 1/8W	293779	91637	Type MFF1/8	1		
R62	Res, met flm, 35,885k ±.01% .3W	342790	18612	Type S102	1		
R63	Res, met flm, 2.67k ±0.1%, 1/8W	340596	03888	Type T9	1		
R64	Res, met flm, 15.4k ±0.1% 1/8W	340604	03888	Type T9	1		
R65	Res, WW, 2.728k ±.05%, .5W	337568	89536	337568	1		
R66, R67, R68	Not Used						
R69	Res, met flm, 27.28k ±.5%, 1/8W	351908			1		

Table 5-13. REFERENCE PCB ASSEMBLY, A12, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R70, R71	Res, set, WW card	339606	89536	339606	2		
R72	Res, met flm, 3.16k ±0.1%, 1/8W	340588	03888	Type T9	1		
R75	Res, var, cermet, 100k ±10%	288308	71450	360S-104A	1		
R76	Res, comp, 910 ±5%, ¼W	203851	01121	CB9115	1		
R78	Res, met flm, 34.8 ±1%, 1/8W	343897	91637	MFF1-834R8 PORM0.5PCT	1		
R79	Res, comp, 2.0M ±5%, ¼W	268771	01121	CB2055	1		
T1	Xformer, RF	324350	89536	324350	1		
T2,T3	Xformer, pulse	345587	89536	345587	2		
U1	IC, TTL, Quad 2-input, Pos NAND Buffer	296228	01295	SN7437N	1		
U2 thru U11	IC, TTL, Expandable, Dual 2-wide, 2-input NAD-or-Invert	340430	01295	SN7450N	10		
U12 thru U15	IC, TTL, Synchronous 4-Bit Counter 2/direct clear	340455	01295	SN74162N	4		
U16	IC, TTL, Synchronous 4-Bit Counter 2/direct clear	340463	01295	SN74163N	1		
U17, U19 thru U22	IC, DCL, MSI 4-Bit Dig Comparator	293258		N8242A	5		
U18	IC, TTL, Hi-Speed, 4-input, Pos NAND Buffer	340414	01295	SN74H40N	1		
U23	IC, TTL, Hi Speed, Triple Input, Pos AND Gate	340448	01295	SN74H11N	1		
U24	IC, TTL, Hi Speed Dual 4-input Pos AND Gate	340422	01295	SN74H21N	1		
U25 thru U28	Not used						
U29	IC Operational Amplifier	225961	34333	SG-8023	1		
U30	IC, Ref. Amp Set		89536	339192	1		
U31, U32	IC, Operational Amplifier	271502	12040	LM301A	2		
U33	IC Linear, op. Amp	284760	34335	LM308	1		

Table 5-13. REFERENCE PCB ASSEMBLY, A12, continued

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U34	IC, Quad 2-input, Nor Gate	288845	01295	SN7402N	1		
XQ	Socket, Xstr	285262	71785	133-23-92-039	13		
XU	Socket, IC 14 contact	276527	23880	TSA-2900-14w	20		
XU	Socket, IC 16 contact	276535	23880	TSA-2900-16W	5		
1	Cable Output	346247	89536	346247	4		
3	Guide retainer - white	341156	89536	341156	6		
4	Shield, Ref. 1	332478	89536	332478	1		
5	Shield, Ref. II	332197	89536	332197	1		
1	Ref. Amp. Set (R41, R42, R46, R49 and U30) must be ordered as complete set	339192	89536	339192	1 Set		

Section 6

Option & Accessory Information

6-1. INTRODUCTION

6-2. This section of the manual contains information on the accessories and options available for the 5200A AC Calibrator.

6-3. ACCESSORY INFORMATION

6-4. The portion of this section dealing with accessories will contain the details of all accessories available for the 5200A.

6-5. OPTION INFORMATION

6-6. Each of the options available for the 5200A are described separately in a sub-section identified with the option name and number. The option description contains the information on the operating instructions and maintenance not covered in the main body of the text plus a complete list of replaceable parts for the option.

TABLE OF CONTENTS

OPTION/ MODEL NO.	DESCRIPTION	PAGE NO.
	Accessories	600-1
	OPTIONS	
01	Remote Control	601-1
02	50-to-400 Hz Power Input	602-1
03	RCU Input Inverter	603-1
04	Not Used	
05	IEEE-488 Interface	605-1

Accessories

600-1. The following table lists the accessories available for the 5200A. Instructions for use accompany each accessory.

Table 600-1. 5200A Accessories

REF DES	ACCESSORY	PART NO.
A4	Service Kit Assy 5200A-7015K	337253
	Extender PCB 5200A-4015	415042
	Adaptr,Female BNC to conhex	207092
	Adaptr,Male BNC to conhex	207100
	Cable, extension, conhex	205906
	Connector, pcb 86—Pin *	335281
——	Rack Mounting Kit	MO7-205-600
——	Chassis Slides	MOO-208-610

* Part of A4; Mfg. Fed. Sply Code 71785, P/N 252-43-30-360

Option —01
Remote Control

601-1. INTRODUCTION

601-2. The —01 Option of the 5200A permits the remote selection of all functions, frequencies and amplitudes by means of an external programming device, usually part of an automated system. (The —01 Option is for use with systems employing negative-active interfacing; systems employing positive-active interfacing must use the —03 Option in addition to the —0n Option). (Refer to Section 603 for details on the —o3 Option.) The remote programming option consists of a Remote Control Unit (plug-in pcb assembly), an 86-pin card-edge connector (John Fluke 5200A-4082) and a blank Address Matrix card (John Fluke 5200A-4083). The Remote Control Unit contains all the control logic and mounts in an assigned position within the 5200A (Installation of the pcb assembly is described in paragraph 601-5). The card edge connector must be jumpered according to system requirements (refer to paragraph 601-21) before being installed to connect the remote programming source to the 5200A. The matrix address card must also be jumpered in accordance with system requirements (refer to paragraphs 601-22 through 601-24) and installed on the Remote Control Unit pcb assembly.

601-3. SPECIFICATIONS

601-4. Specifications for the Remote Control Unit are contained in Section 1 of the manual.

601-5. INSTALLATION

NOTE!

Before installing the RCU in the 5200A, install a properly jumpered Address Matrix card on the RCU as shown in Figure 601-1. Jumpering information for the Address Matrix card is contained in paragraphs 601-22 through 601-24.

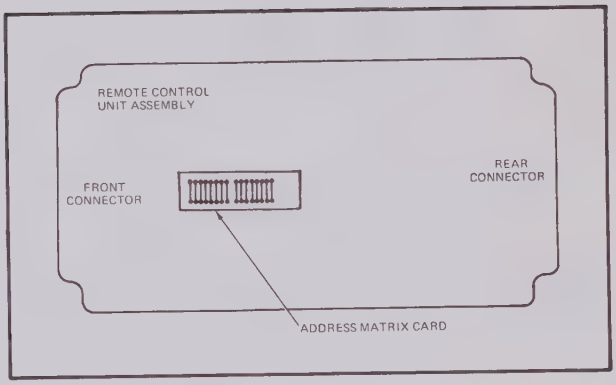


Figure 601-1. Location of Address Matrix Card

601-6. The RCU (pcb assembly number 5200A-4080) mounts in an assigned position within the 5200A as shown in Figure 601-2. Install the RCU as follows:

1. Remove the top dust cover.
2. Remove the large inner cover located in the left section (as viewed from the top front).
3. Install the RCU assembly in the gray (eighth) position and slide fully forward to engage the printed circuit board connector. Refer to Figure 601-2.
4. Replace the large inner cover, making sure that all of the printed circuit board locating pins protrude through the holes in the cover.
5. Replace the top dust cover.

601-7 OPERATION

601-8. General

601-9. Once installed in the 5200A, the RCU requires no operator attention. However, operation of the RCU in a system environment must be understood in order to interface with a remote programming source. The following paragraphs contain the information

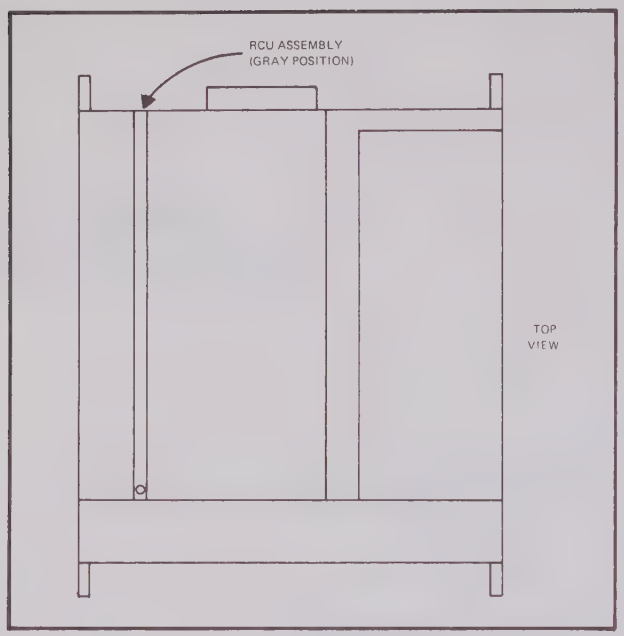


Figure 601-2. RCU Mounting Location

necessary to interface a remote programming source to the RCU, i.e. the jumpering of the Address Matrix card, the connection of the data inputs, the use of the flag outputs, etc.

601-10. Logic Levels

601-11. Programming inputs to the Remote Control Unit are DTL and TTL compatible. In the —01 Option only, negative-true logic is used and a logic 0 is equal to +2.0V to +5Vdc, and logic 1 is equal to 0.4, ±0.4Vdc. When the —03 Option is included with the —01 Option, the Remote Control Unit accepts positive-true logic, i.e., a logic 0 is equal to 0.4, ±0.4Vdc, and a logic 1 is equal to +2.0V to +5Vdc. In either case, logic 1 is the active state.

601-12. Selection of Frequency And Amplitude Ranges.

601-13. Any of five frequency ranges and seven amplitude (voltage) ranges can be remotely programmed via the rear panel connector pins (even numbered 54 through 64) listed on Table 601-1. The ranges are octal coded, as listed in Tables 601-2 and 601-3, so that only three pin connections are required to encode any of the frequency and amplitude ranges. For example, to select the 100kHz frequency range, logic 0's would be placed on pins 60 and 62, and logic 1 on pin 64. Each of the frequency and amplitude ranges can be programmed for up to 20% overrange by placing a logic 0 on the appropriate connector pin. Pin 49 is used to select the amplitude overrange; pin 53 is used to select the frequency overrange. The overrange permits selection of up to 1.199999 on any amplitude range and up to 1.1999 on any frequency range.

601-14. Selection Of Frequency And Amplitudes

601-15. Each digit of frequency and amplitude can be remotely selected when the calibrator is placed in the remote mode. As listed in Table 601-1, each decimal digit requires binary coding via a group of four input lines. Frequency selection is made by means of four digits, each of which have an assigned group of four binary-coded input lines. Amplitude selection is made by means of six digits, each of which also have an assigned group of four binary-coded input lines.

601-16. Selection Of Control Functions

601-17. A group of four functional commands is provided to control the 5200A from the remote programming source.As listed in Table 601-1, these commands are entered on even numbered pins 80 through 86. Pin 86 controls the operating mode of the 5200A; a logic 0 places the calibrator in the Operate mode while a logic 1 places the calibrator in the Standby mode (i.e., 1mV range selected and the output disconnected). Pin 84 controls the phase lock operation of the calibrator in a manner similar to the front panel PHASE LOCK switch. A logic 0 selects the phase lock feature so that the calibrator can be locked to some external reference frequency connected to rear panel connector J64. A logic 1 disables the phase lock feature.

601-18. Pin 82 controls the remote selection of the calibrator. A logic 1 places the 5200A in the remote control mode so that it may disable the front panel controls and be under the control of the remote programming device. A logic 0 disables the remote control logic and enables the front panel controls unless the front panel CONTROL switch is placed in the REM position, in which case the 5200A remains in the remote control mode. Pin 80 controls the sense connections in a manner similar to the front panel SENSE switch. A logic 1 switches the sensing to external, i.e., output sensing takes place at the load. A logic 0 switches the sensing to internal, i.e., output sensing takes place within the 5200A.

601-19. SERIAL PROGRAMMING

601-20. The remote programming of frequency ranges, amplitude ranges, frequencies, amplitudes, control functions, frequency overrange and amplitude overrange may be made in serial or parallel form, depending upon the particular system environment. Program data generated by the program source is in the form of a 54-bit program word, made up of 15 bytes. The program word is fed to a 54-bit input register in the Remote Control Unit (RCU). When serial programming is employed, the program word is fed over a common set of four data lines to the register, one byte at a time. Each

Table 601-1. Card-Edge Connector Pin Assignments

PIN NO.	FUNCTION
1	LSB (1) of amplitude least significant digit
3	3SB (2)
5	2SB (4)
7	MSB (8)
9	LSB (1) fifth
11	3SB (2)
13	2SB (4)
15	MSB (8)
17	LSB (1) fourth
19	3SB (2)
21	2SB (4)
23	MSB (8)
25	LSB (1) third
27	3SB (2)
29	2SB (4)
31	MSB (8)
33	LSB (1) second
35	3SB (2)
37	2SB (4)
39	MSB (8)
41	LSB (1) most
43	3SB (2)
45	2SB (4)
47	MSB (8)
49	Amplitude overrange bit – provides 1.199999 on any range
51	not used
53	frequency overrange bit – provides 1.1999 on any range
55	MSB (8) of frequency most significant digit
57	2SB (4)
59	3SB (2)
61	LSB (1)
63	MSB (8) second

NOTE

For Option –01 (RCU only):

Logic 1 = 0V to +0.8V
Logic 0 = +2V to +5V

For Option –01 and –03 (RCU plus Inverter):

Logic 1 = +2V to +5V
Logic 0 = 0V to +0.8V

Table 601-1. Card-Edge Connector Pin Assignments (Continued)

PIN NO.	FUNCTION
65	2SB (4) of frequency second significant digit
67	3SB (2)
69	LSB (1)
71	MSB (8) of frequency third significant digit
73	2SB (4)
75	3SB (2)
77	LSB (1)
79	MSB (8) least
81	2SB (4)
83	3SB (2)
85	LSB (1)
2	not used
4	
6	
8	
10	
12	remote control flag – logic 1 indicates remote mode available
14	ready/$\overline{\text{ready}}$ flag – logic 1 indicates 5200A not yet settled
16	+5V common
18	overload flag – logic 1 indicates the 5200A (or 5205A) output is overloaded
20	5205A operate flag – logic 1 indicates operate mode (0 = standby)
22	5200A operate flag – logic 1 indicates operate mode (0 = standby)
24	+5Vdc
26	not used
28	
30	
32	
34	MSB (8) of group address
36	2SB (4)
38	3SB (2)
40	LSB (1)

permits serial entry of remote control data

NOTE

For Option –01 (RCU only):

Logic 1 = 0V to +0.8V
Logic 0 = +2V to +5V

For Option –01 and –03 (RCU plus Inverter):

Logic 1 = +2V to +5V
Logic 0 = 0V to +0.8V

Table 601-1. Card-Edge Connector Pin Assignments (concluded)

PIN NO.	FUNCTION
42	Address strobe – enters data group selected by group address
44	Parallel address – causes parallel entry of remote control data
46	not used
48	
50	
52	
54	MSB (4) of amplitude range
56	2SB (2)
58	LSB (1)
60	LSB (1) frequency
62	2SB (2)
64	MSB (4)
66	not used
68	
70	
72	
74	
76	
78	
80	remote sense command – logic 1 = 5200A in external sense; 0 = internal sense
82	remote control command – logic 1 = 5200A in remote control; 0 = local
84	phase lock command – logic 1 = 5200A in phase lock mode
86	operate command – logic 1 = 5200A operate mode; logic 0 = standby

refer to Table 6-3

refer to Table 6-2

NOTE

For Option –01 (RCU only):

Logic 1 = 0V to +0.8V
Logic 0 = +2V to +5V

For Option –01 and –03 (RCU plus Inverter):

Logic 1 = +2V to +5V
Logic 0 = 0V to +0.8V

NOTE:
MSB = Most significant bit
LSB = Least significant bit

portion of the input register is addressable, and as a byte of data is placed on the four data lines, the designated portion of the input register is addressed, and then strobed. In this manner, the remote programming source can fill the RCU input register, byte-by-byte, with the required frequency, amplitude, range and control information. When the input register is loaded a data transfer command is addressed and the 5200A reacts to the program data.

601-21. To accomodate serial programming, eight data lines must be connected to the RCU connector as shown in Figure 601-3. Four of the data lines carry the byte address (0 through 15), while the other four lines carry the program data. The program data lines are multiple-connected so that all elements of the 54-bit input register have access to the data, although only the addressed portion of the register will accept and store the data at any given time. Note in Table 601-4 that the

Table 601-2. Frequency Range Coding

SELECTED RANGE	OCTAL CODING (BCD Pins 60 (BCD 1), 62 (BCD 2) and 64 (BCD 4)
100 Hz	0
1 kHz	1
10 kHz	2
100 kHz	3
1 MHz	4

Table 601-3. Amplitude Range Coding

SELECTED RANGE	OCTAL CODING (BCD) Pins 54 (BCD 4), 56 (BCD 2) and 58 (BCD 1)
1 mV	1
10 mV	2
100 mV	3
1 V	4
10 V	5
100 V	6
1000 V	7

NOTE

If a zero (0000_2) is programmed, the 1 mV range will be selected.

frequency range and amplitude range data require only three bits for range coding; consequently, these portions of the input register are multiple-connected only to the first three data lines and have no connection to the most significant data line. Also, the frequency and amplitude overrange bytes require only a single bit each. As a result, these bits are connected to only one of the four data lines. The data line drivers within the remote programming source must be capable of supplying sufficient current for 15 TTL input loads (i.e., 1 mA for each data line).

601-22. For purposes of serial programming, each byte of program data (i.e., frequency digit, range, control functions, etc.) has an assigned unique address which is determined by the strapping of the Address Matrix card on the RCU. A typical strapping configuration is shown in Figure 601-4 to accommodate serial programming of the 5200A. With the strapping of the Address Matrix card as shown in Figure 601-4, the control functions byte has address 14, the frequency range byte has address 13, the least significant frequency digit has address 12, etc. (The transfer data command, which tells the RCU that the 54-bit program word has been loaded or changed as required, has byte address 15 in Figure 601-4.

601-23. The byte addressing is performed by the program source which feeds the binary-coded address (via even-numbered RCU pins 34 through 40) to a 1-out-of-16 decoder. The decoder produces an output in response to the input bit configuration to enable that portion of the input register jumpered to the enabled output. In this manner, only one portion of the input register is enabled at any given time.

601-24. The Address Matrix card permits the assignment of byte number to the different input register elements as required for various system configurations. Regardless of how the Address Matrix card is jumpered, the 54-bit program word must be placed in the assigned positions of the input register as shown in Figure 601-4. For example, if it is desired to transpose the byte numbers of the amplitude range byte and the frequency range byte, pin 8 (on the Address Matrix card) is jumpered to pin 31 and pin 14 is jumpered to pin 25. With this configuration, the amplitude range byte must be addressed as byte 13, and the frequency range byte must be addressed as byte 7.

601-25. As previously mentioned, not all bytes in the 54-bit program word are made up of four bits; the two

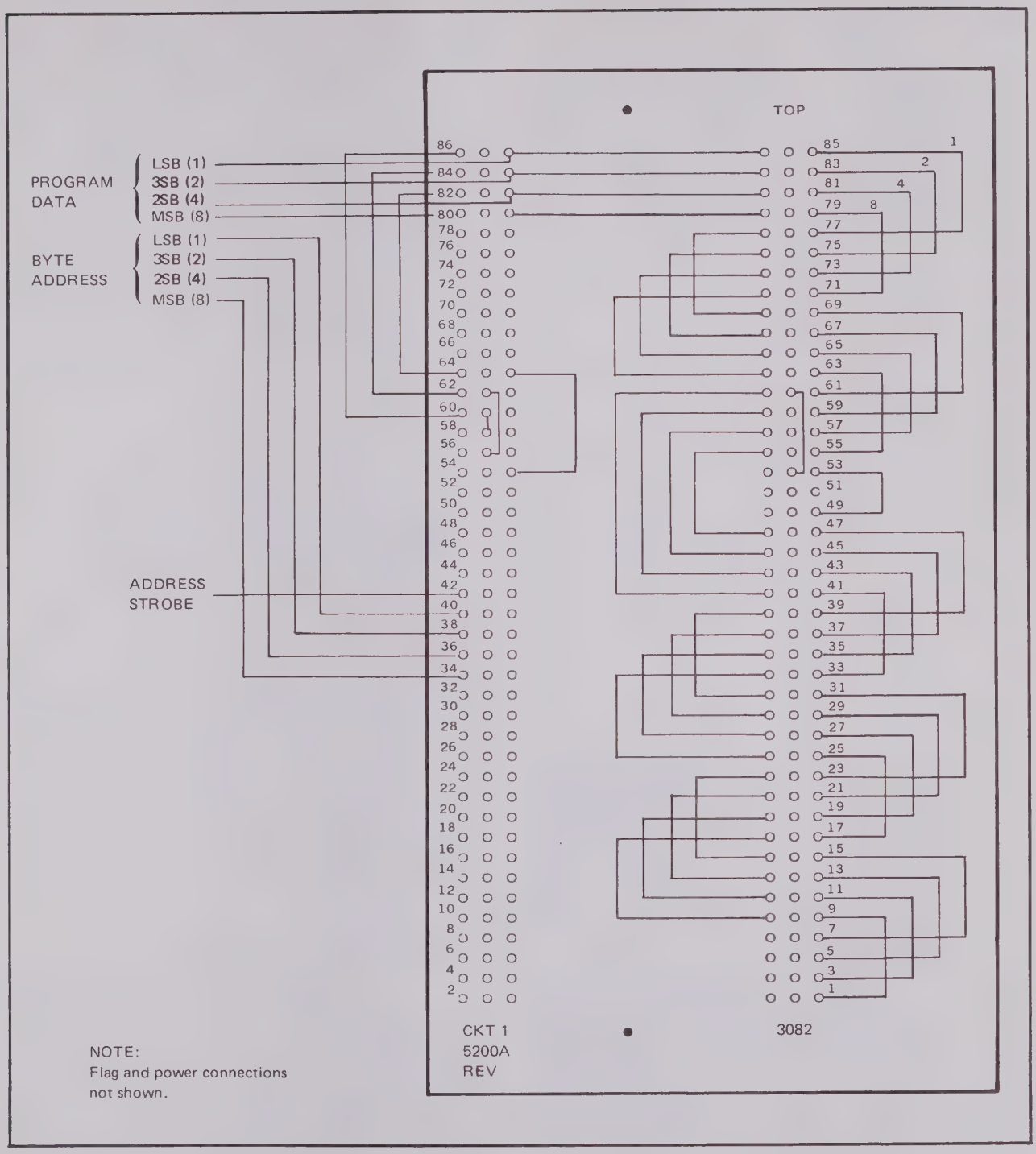


Figure 601-3. Typical Serial Programming Connections

range bytes are 3 bits each, and the overrange bytes are one bit each. Any data appearing on the unused data line(s) when addressing the range or overrange bytes, is disregarded by the RCU logic. The assignment of the used and unused data lines when addressing the range and overrange bytes is determined by the RCU card edge connector jumpers shown in Figure 601-3. For example, the overrange bit inputs to the shift register (connector pins 49 and 53) are jumpered to the least significant program line; the range inputs to the input register are jumpered to the three least significant program lines. Any data appearing on the unused program line(s) is disregarded.

Table 601-4. Typical Byte Assignment For Serial Programming

BYTE ADDRESS	BYTE NAME
0	Amplitude overrange bit (one bit)
1	MSD (four bits)
2	2SD (four bits)
3	3SD (four bits)
4	4SD (four bits)
5	5SD (four bits)
6	LSD (four bits)
7	range selection (three bits)
8	Frequency overrange bit (one bit)
9	MSD (four bits)
10	2SD (four bits)
11	3SD (four bits)
12	LSD (four bits)
13	range selection (three bits)
14	Control functions — remote/local sense, phase lock, remote/local operation, standby/operate. (four bits) Bit assignment depends on connector jumpers — refer to Figure 6-1.
15	Data transfer command (no data required)

601-26. Program Sequence And Timing-Serial

601-27. It is the function of the remote programming source to address the different elements of the RCU input register, and shift the appropriate data to the addressed element (byte). The byte addresses assigned to the different elements of the input register are determined by the jumpering arrangement on the Address Matrix card as described in paragraphs 601-22 through 601-24. It is not necessary to completely re-program the 5200A each time it is desired to change the output signal. It is only necessary to change those elements of the input register required to bring about the change. For example, if it is desired to simply change the amplitude range with no alteration of the amplitude data or frequency, only the amplitude range byte of the input register need be addressed and the new byte entered. Since none of the other input register bytes have been addressed, their contents will not be changed.

601-28. Whenever a data byte is placed on the program data lines shown in Figure 601-3, and the respective byte address is placed on the byte address lines (pins 34, 36, 38 and 40), an address strobe pulse must be generated at pin 42 in order for the RCU to receive the data byte. The address strobe pulse is a negative-going 800-ns (minimum) pulse applied to pin 42 of the card edge RCU connector. The data byte(s) and byte address may be altered at any time except during the strobe pulse. Coincident with the end of the strobe pulse is a READY flag which indicates (when in the low, or logic 1 state) that the 5200A is not yet settled and the output signal is unreliable. The READY flag is low for 0.5 seconds when using the upper four frequency ranges, and 4.0 seconds when using the 100 Hz frequency range. Refer to Figure 601-5.

NOTE!

If the output amplitude is one half scale or less, the actual settling time may exceed the READY FLAG when the output frequency is between 10 Hz and 30 Hz on the 100 Hz range or between 100 Hz and 400 Hz on the 1 kHz range. Refer to RESPONSE TIME Specifications in Section 1.

601-29. When the desired 54-bit program word has been serially loaded into the input register, no action will be taken by the 5200A upon the program word until the transfer data command is addressed and strobed. To address the transfer data command, the address of the command (determined by the jumpering of the Address Matrix card) is placed on the byte address lines. When the subsequent address strobe pulse occurs, the 5200A acts upon the 54-bit program word and changes its output signal accordingly.

601-30. Parallel Programming

601-31. The remote programming of frequency ranges, amplitude ranges, frequencies, voltages, control functions, frequency overrange and amplitude overrange may be made in parallel as well as serial form. All program data generated by the program source is in the form of a 54-bit program word, made up of 15 bytes. The program word is fed to a 54-bit input register in the RCU. Connection of the program data to the RCU is made by means of the card edge connector using the pin assignments listed in Table 601-1. Since each data bit has an assigned unique line, there is no need for multiple connections on the card edge connector, as in the case of serial programming.

601-32. The Address Matrix card, located on the RCU as shown in Figure 601-1, must be jumpered to accomodate the parallel programming format. A typical jumper arrangement for the Address Matrix card to

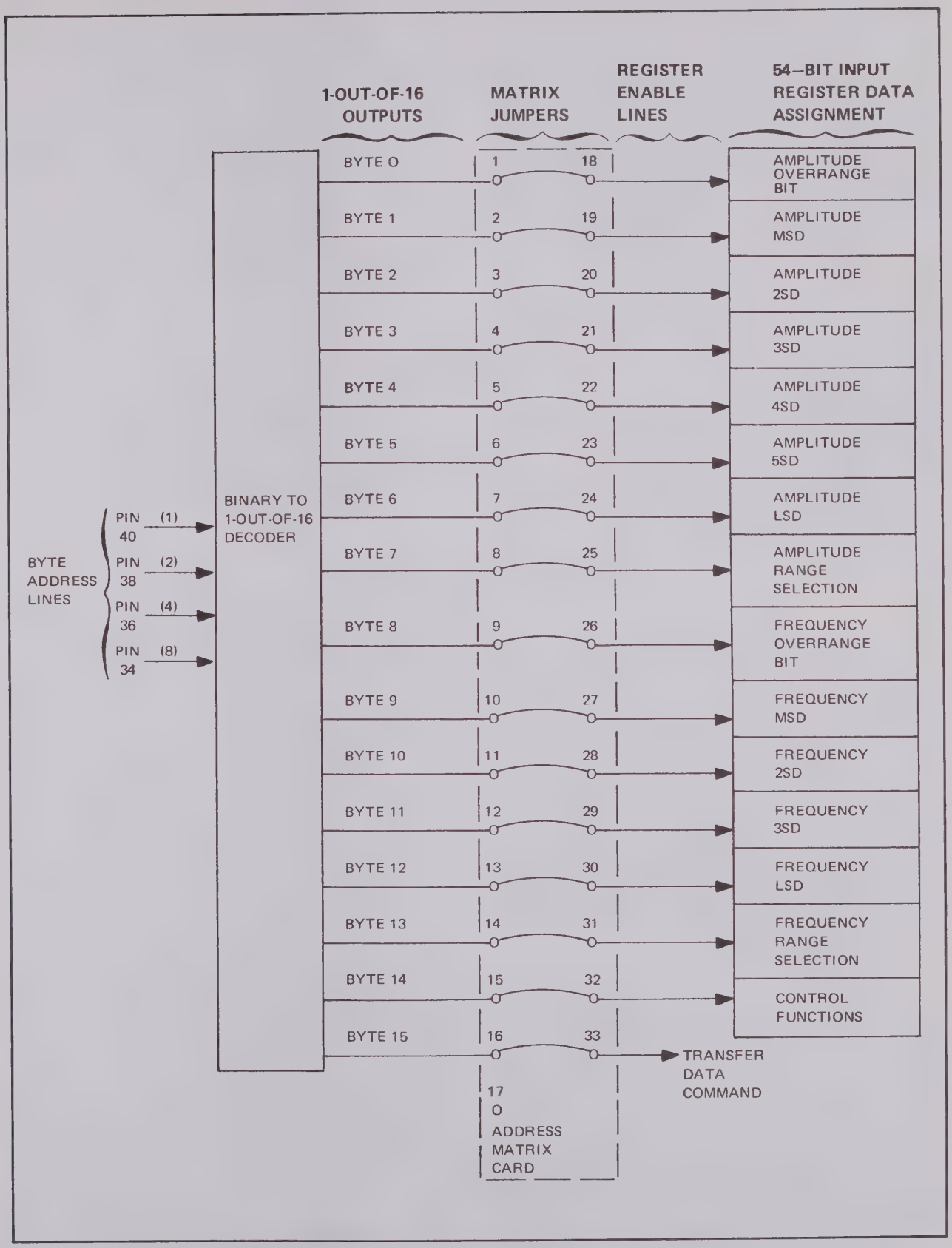
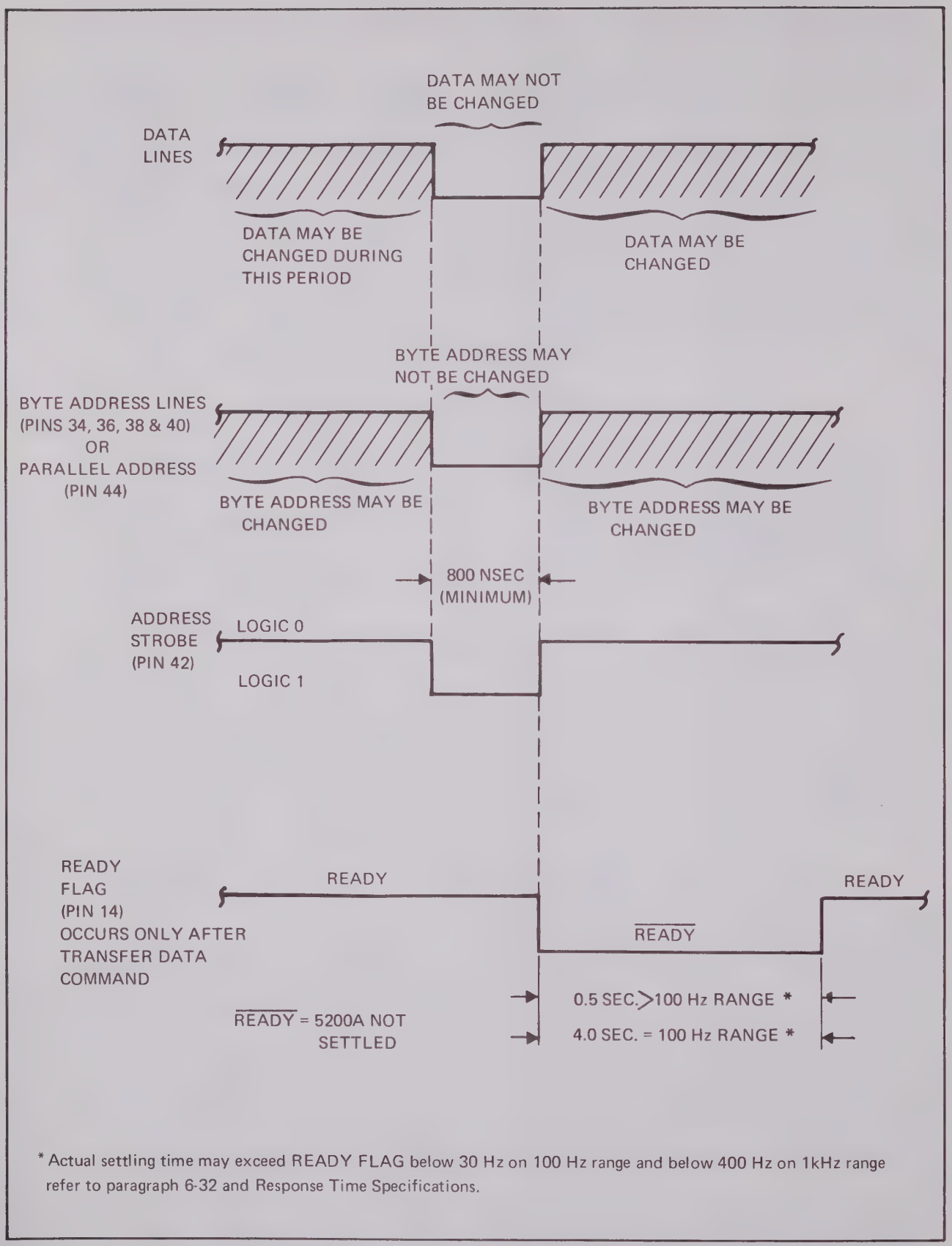


Figure 601-4. Typical Address Matrix Card Jumpers-Serial Program


DATA MAY NOT BE CHANGED
DATA LINES
DATA MAY BE CHANGED DURING THIS PERIOD
DATA MAY BE CHANGED
BYTE ADDRESS MAY NOT BE CHANGED
BYTE ADDRESS LINES (PINS 34, 36, 38 & 40) OR PARALLEL ADDRESS (PIN 44)
BYTE ADDRESS MAY BE CHANGED
BYTE ADDRESS MAY BE CHANGED
800 NSEC (MINIMUM)
ADDRESS STROBE (PIN 42)
LOGIC 0
LOGIC 1
READY FLAG (PIN 14) OCCURS ONLY AFTER TRANSFER DATA COMMAND
READY
READY
READY
0.5 SEC. >100 Hz RANGE *
4.0 SEC. = 100 Hz RANGE *
READY = 5200A NOT SETTLED

* Actual settling time may exceed READY FLAG below 30 Hz on 100 Hz range and below 400 Hz on 1kHz range refer to paragraph 6-32 and Response Time Specifications.

Figure 601-5. RCU Timing Requirements

accomodate parallel programming is shown in Figure 601-6. The parallel address input (pin 44) is fed through a buffer and connected to each addressable portion of the 54-bit input register and to the transfer data command terminal of the Address Matrix card. The buffer provided in the parallel address line generates sufficient drive for all portions of the input register and the transfer data command.

601-33. The loading of the 54-bit program word into the 54-bit input register takes place when the program word is applied to the register inputs and the parallel address input is made to go to logic 0 while an address strobe signal is applied to pin 42. Since the parallel address signal is applied to all portions of the input register, and also to the transfer data command, the occurance of the address strobe causes the 54-bit program word to be accepted into the input register and then used to select the programmed output of the 5200A. The timing diagram in Figure 601-5 shows how the READY flag goes to logical 0 after the 800-ns (minimum) address strobe pulse to indicate that the calibrator output is not yet settled to the programmed frequency and/or amplitude.

601-34. Flags

601-35. The 5200A produces five flag outputs via the RCU card edge connector pins 12, 14, 18, 20 and 22 as listed in Table 601-1. Pin 12 provides connection to the remote control flag. A logic 0 at pin 12 indicates to the remote programming source that the 5200A is in the remote control mode, either as a result of remote control function or the front panel CONTROL switch. A logic 0 at pin 18 indicates that either or both the 5200A and 5205A are overloaded at their outputs. A logic 1 at pin 20 indicates that the 5205A (if included in the system) is in the operate mode; a logic 0, the Standby mode. A logic 0 at pin 22 indicates that the 5200A is in the Operate mode, a logic 1, the Standby mode. The ready flag appearing at pin 14 is described in previous paragraphs.

601-36. THEORY OF OPERATION

601-37. The function of the RCU is to receive and store operational commands and parameters from some remote programming source, and where necessary, pass them through the guard shield to control the output frequency output amplitude and operating mode of the calibrator. The RCU can receive remote control information in parallel or serial byte-by-byte form, depending upon the system requirements. Programming format is determined by the strapping arrangement on the Address Matrix card (refer to paragraph 601-22 through 601-24.

601-38. Serial Operation

601-39. Figure 601-7 shows that the 54 bits of programming data are fed to a 33-bit shift register and a 21-bit storage latch (two sets of five, four-bit storage latches, plus a J-K flip-flop for the amplitude overrange bit). All 54 bits are fed over a set of four data lines, one byte at a time. Each byte of the shift register and storage latches is separately addressable and its inputs are enabled by means of the four address lines and the Address Matrix card. As each byte of program data is placed on the four data lines, the corresponding byte address is placed on the four byte address lines. This action enables that portion of the shift register or storage latches and places the byte of program data in the assigned position.

601-40. The Address Matrix card operates in conjunction with a four-to-sixteen-line decoder so that four bits of byte address information can be used to address any of the 15 different bytes of the register and storage latches. (The 33-bit shift register contains 9 assigned bytes; the 21-bit storage latch contains 6 assigned bytes.) In addition, the 4 bits of byte-address information can address the transfer data command when all data has been entered. To permit all program data to pass over the 4 data lines, each of the 15 bytes are miltiple-connected. Those bytes having only 3 meaningful bits (frequency range and amplitude range), and those bytes having only one meaningful fit (frequency overrange and amplitude overrange) are multiple-connected to the low order bit(s) of the data lines only.

601-41. During serial operation, the RCU loads each byte of the shift register and storage latches (under the direction and control of the remote programming source) with the necessary frequency, amplitude or control data, and then address the transfer data command. As shown in Figure 601-7, the transfer data command performs three functions;i.e., start the gate-clock circuit, cause the 20-bit storage latch and trigger a one shot multivibrator. The starting of the gated-clock circuit causes the generation of 33 serial clock pulses which are fed to the serial shift input of the 33-bit shift register. The 33 pulses at the serial shift input cause the register to perform one complete shift cycle by shifting all data, bit-by-bit, from the serial output back to the serial input.

601-42. As the program data is shifted around the shift register loop, it is also transformer-coupled through an opening in the guard shield to a second 33-bit shift register located inside the guard shield. The second shift register also receives the 33 clock pulses and stays in synchronism throughout the serial transfer of the program data. The result of the shifting action is that all 33 bits of program data are passed through a single opening (instead of 33 parallel openings) in the guard shield and are stored in the second shift register until altered by the next 54-bit program data word and transfer data command. While held in the second shift register, the program data selects the calibrator output mode.

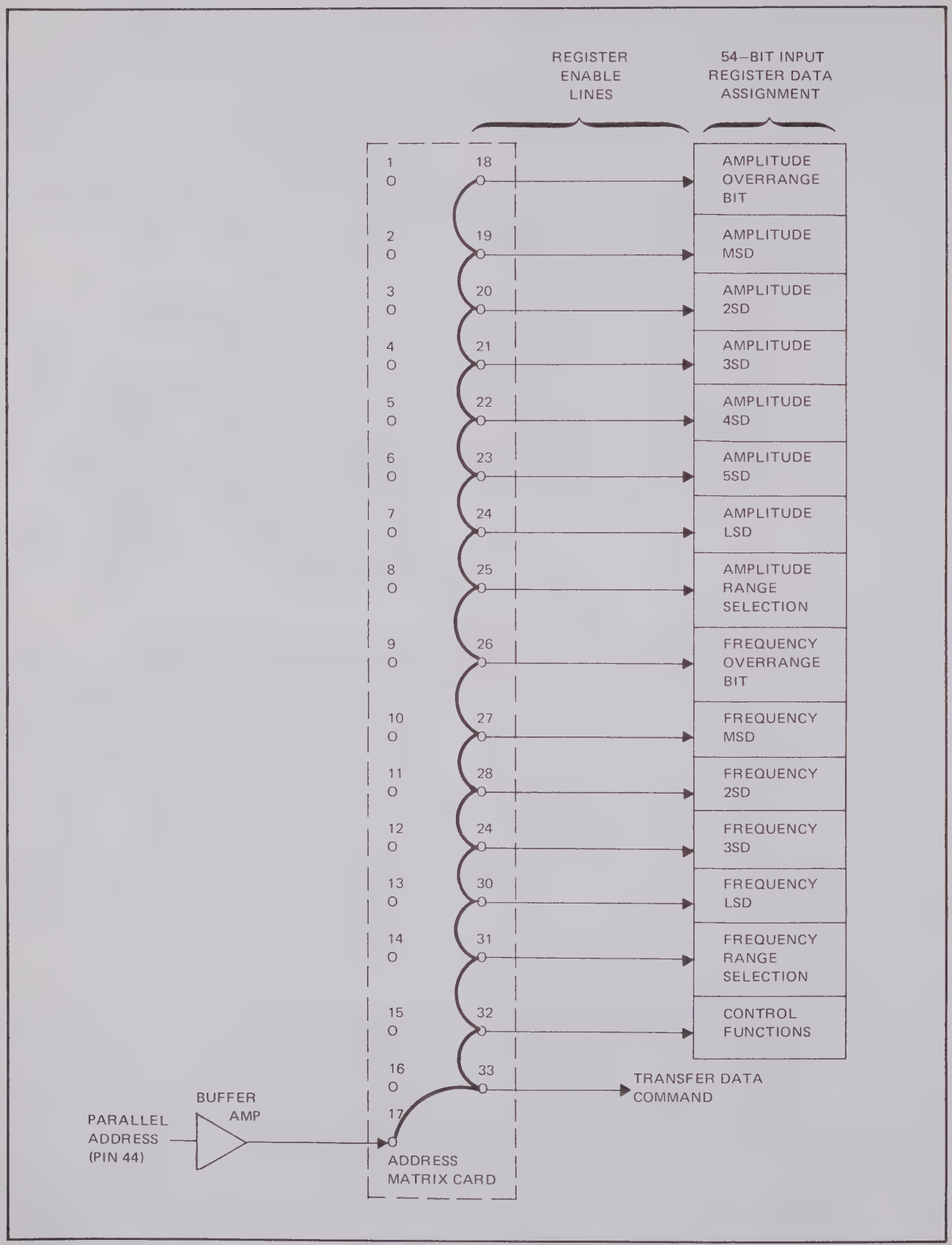


Figure 601-6. Typical Address Matrix Card Jumpers - Parallel Program

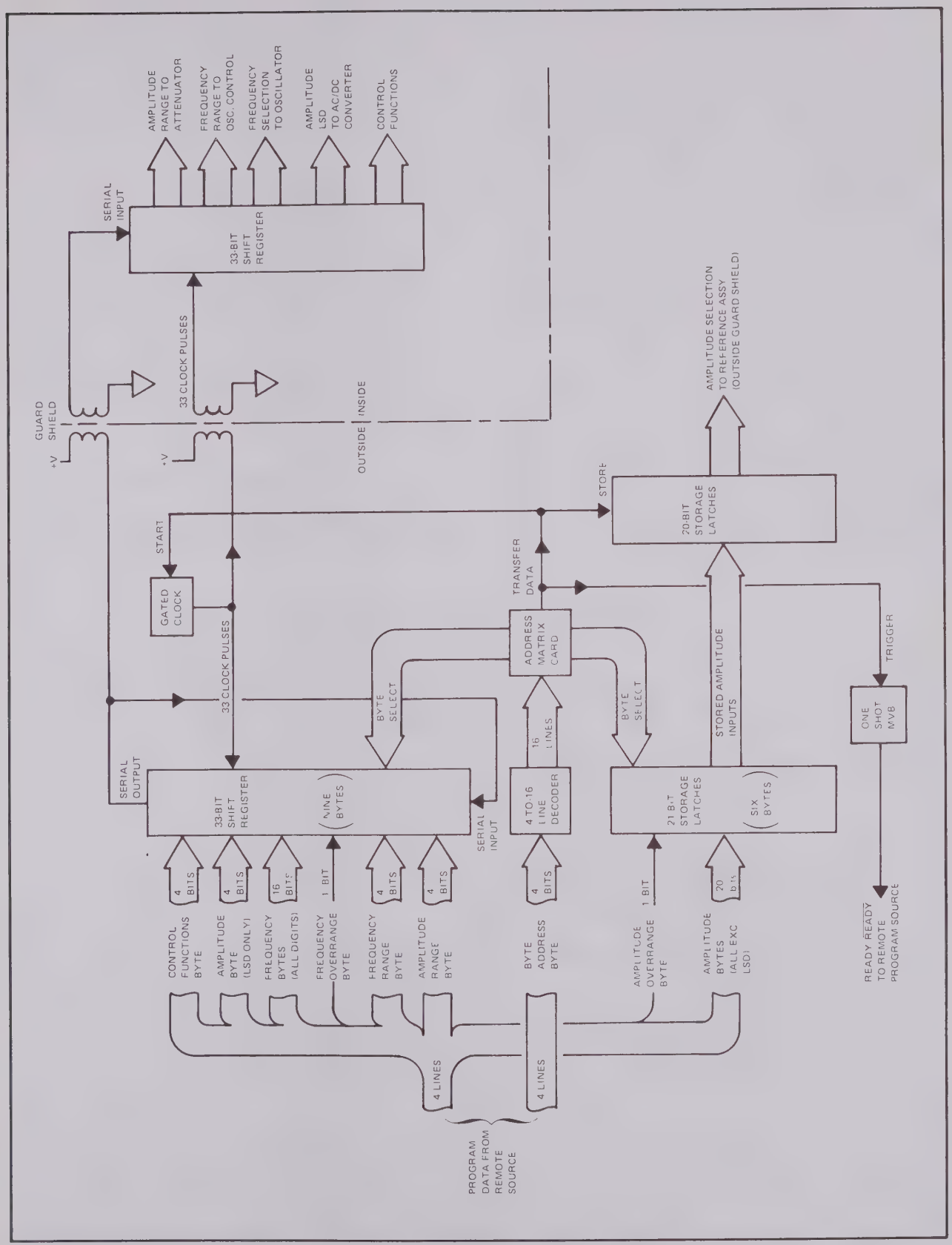


Figure 601-7. RCU, Serial Operation, Data Flow Diagram

601-45. Parallel Operation

601-46. Parallel operation of the RCU is identical to that described for serial operation, except for the method of loading the program data into the first 33-bit shift register and the 21-bit storage latch. In the parallel configuration, the remote programming source feeds all 54 bits of program data in parallel form to the RCU at one time, as shown in Figure 601-8. No byte address lines are used, so the parallel address input is used to address all bytes of the shift register, all bytes of the storage latches and the initiate transfer command simultaneously. Sufficient delay is provided between the parallel shift of the data (into the shift register and the storage latch) and the starting of the clock pulses, so that all data is settled before serialization begins.

601-43. The transfer data command also causes the 20-bit storage latch to accept the program data from the 2l-bit storage latch. (The 21st, or amplitude overrange, bit is not lost, but is used to adjust the binary value of the program data [20 bits] fed to the second set of storage latches.) The program data fed to the20-bit storage latches does not require serialization since it is not fed through the guard shield, and the use of 20 parallel conductors is of no consequence. The program data held in the 20-bit storage latch (the amplitude data except for the least significant digit) controls output amlitude and is fed to the reference assembly located (electrically) outside the guard shield. (The least significant digit of amplitude data is passed serially to the second shift register for application to the AC-DC Converter inside the guard shield.)

601-44. The transfer data command also triggers a one-shot multivibrator to generate a READY signal to the remote programming source. The presence of the READY signal during the serialization and transfer of the program data notifies the remote program source that the RCU is not ready to accept new program data (data-line and address-line information may be changed, but new data cannot be strobed into new address location). The duration of the READY one-shot is 4 seconds on the 100 Hz range and 0.5 seconds on all other ranges. This one-shot provides sufficient settling time for the calibrator output.

601-47. LIST OF REPLACEABLE PARTS

601-48. Tables 601-5 and 601-6 list the replaceable parts for the RCU. Refer to Section 5 for an explanation of the columnar entries.

Table 601-5. Remote Control Option (—01) Parts List

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	REMOTE CONTROL OPTION (—01) (Field-Installable Kit) 5200A—01K						
A11	**PCB Assembly, RCU (Coded: Gray) (Refer to Table 6-7)**	332676	89536	332676	1		
	Address matrix card, programmable	350058	89536	350058	1		
	Connector assembly, RCU	337840	89536	337840	1		

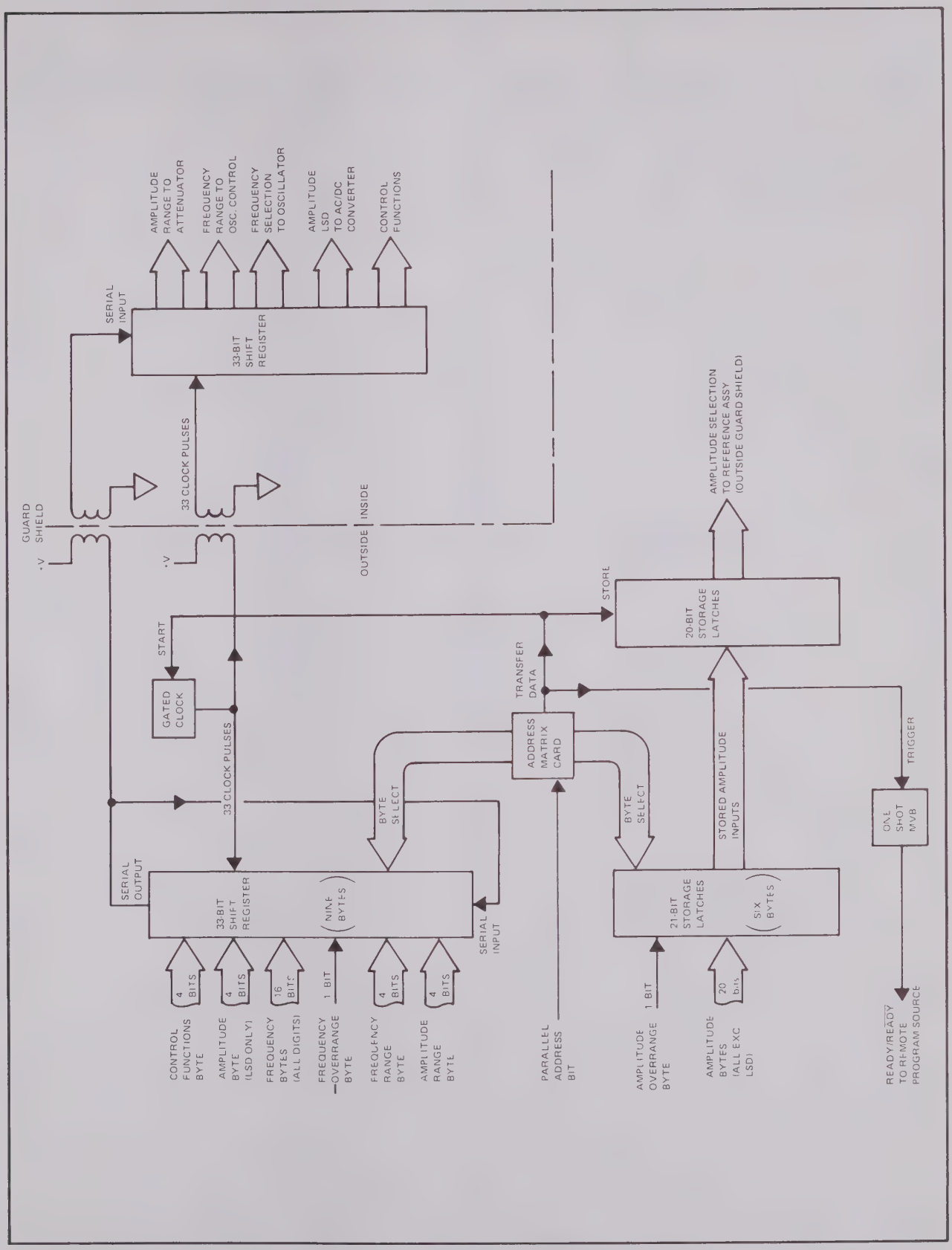


Figure 601-8. RCU, Parallel Operation, Data Flow Diagram

Table 601-6. Remote Control PCB Assembly, A11, Parts List

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	**PCB Assembly, RCU OPTION –01 (Figure 8-16)**	337626	89536	337626	REF		
C1	Cap, mica, 510 pF, ±5%, 500V	148411	53021	D19FD511J03	1		
C2, C5	Cap, mica, 82 pF, ±5%, 500V	148502	53021	D15ED820J03	2		
C3, C4	Cap, mica, 43 pF, ±1%, 500V	277202	53021	D15ED430F03	2		
C6	Cap, Ta, 30 uF, ±20%, 20V	163915	56289	196D396X0006	1		
C7,C8, C12 thru C15, C17 thru C26 C29, C30	Cap, cer, 0.025 uF, ±20%, 100V	168435	56289	C023B101H253-M	18		
C9	Cap, Ta, 330, uF, ±10%, 6V	193011	56289	150D330X9006 S2	1		
C10	Cap, mica, 33 pF, ±5%, 500V	160317	53021	D15ED330J03	1		
C11	Cap, plstc, 4700 pF, ±10%, 50V	260844	06001	75FIR5A472	1		
C16	Not used						
C27, C28	Cap, Ta, 10 uF, 20%, 20V	330662	07263	196D106X0020 JA1	2		
C31	Cap, mica, 390 pF, ±5%, 500V	148437	71236	DM15F391J	1		
CR1 thru CR7	Diode, Si, 150 mA	203323	01295	1N4148	7	2	
Q2, Q9 thru Q28	Xstr, Si, pnp	195974	04713	2N3906	21	5	
Q3 thru Q8	Xstr, Si, npn	159855	09719	CS23030	6	2	

Table 601-6. Remote Control PCB Assembly, A11, Parts List (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R1,R7, R11, R15, R17, R19, R21, R32 thru R51, R54, R59	Res, comp, 10k, ±5%, ¼W	148106	01121	CB1035	29		
R2, R4	Res, comp, 2k, ±5%, ¼W	202879	01121	CB2025	2		
R3	Res, comp, 2.7k, ±5%, ¼W	170720	01121	CB2725	1		
R5, R6	Res, met film, 22.1k, ±1%, 1/8W	235234	91637	MFF1-82212F	2		
R8, R9, R10, R12, R13, R52, R53, R55, R56	Res, comp, 1k, ±5%, ¼W	148023	01121	CB1025	9		
R14, R16, R18, R20	Res, comp, 6.2k, ±5%, ¼W	221911	01121	CB6225	4		
R22	Res, comp, 1.8k, ±5%, ¼W	175042	01121	CB1825	1		
R23	Res, comp, 820, ±5%, ¼W	148015	01121	CB8215	1		
R24	Res, met film, 17.4k, ±1%, 1/8W	236802	91637	MFF1-81742F	1		
R25	Res, met film, 5.76k ±1%, 1/8W	260349	91637	MFF1-85761F	1		
R26, R29	Res, comp, 200 , ±5%, ¼W	193482	01121	CB2015	2		
R27, R28	Res, comp, 3.3k, ±5%, ¼W	148056	01121	CB3325	2		
R30	Res, met film 30.1k, ±1%, 1/8W	168286	91637	MFF1-83012F	1		
R31	Res, met film, 10k, ±1%, 1/8W	168260	91637	MFF1-81002F	1		

Table 601-6. Remote Control PCB Assembly, A11, Parts List (Cont'd.)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
R57, R58	Res, comp, 51, ±5%, ¼W	221879	01121	CB5105	2		
R60	Res, comp, 4.7k ±5%, ¼W	148072	01121	CB4725	1		
T1A, T1B, T2A, T2B	Xfmr, pulse	345587	89536	345587	4		
U1 thru U9	IC, TTL, 4-bit, right/left shift reg.	342691	04713	MC7495P	9	2	
U10, U19, U29	IC, TTL, monostable multivibrator	293050	01295	SN74121N	3	1	
U11	IC, TTL, MSI, 4 line to 16 line decoders/ demultiplexers	293217	01295	SN74154N	1	1	
U12, U50	IC, TTL, quad, 2-input pos, OR gate	342709	07263	SN7432	2	1	
U13, U14, U35	IC, TTL, hex inverter	292979	01295	SN7404N	3	1	
U15	IC, TTL, hex inverter buffer/driver	288605	01295	SN7416P	1	1	
U16, U39	IC, TTL dual retrig, mono, mv	310235	01295	SN74123N	2	1	
U17, U18	IC, TTL, MSI, decade counter	293159	01295	SN7 490N	2	1	
U20, U28, U41	IC, TTL, quad 2-input pos AND gate	292987	01295	SN7408N	3	1	
U21, U44, U45	IC, TTL, dual D-type edge-trig flip-flop	310227	01295	SN7474N	3	1	
U22, U46	IC, TTL, dual 4-input, pos NAND gate	293001	01295	SN7420N	2	1	
U23	IC, TTL, dual J-K flip-flop	293043	01295	SN74107N	1	1	
U24	IC, TTL, quad 2-input NOR gate	288845	01295	SN7402N	1	1	

Table 601-6. Remote Control PCB Assembly, A11, Parts List (Concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
U25, U26, U30, U47, U58	IC, TTL, MSI, dual 4-bit latch	293191	07263	U6N930859X	5	1	
U27	IC, TTL, dual peripheral pos NAND driver	329706	01295	SN75452P	1	1	
U31 thru U34	Optical isolator	312298	29083	Q1813	4	1	
U36, U40, U42, U43	IC, TTL, 8-bit shift register	272138	12040	DM8570	4	1	
U37, U38	IC, TTL, tri-state quad buffer	331199	12040	DM8094N	2	1	
U49	IC, TTL, quad, 2-input NAND gate	292953	01295	SN7400N	1	1	
	Cable, output	346247	89536	346247	1		
	Fence set	341917	89536	341917	1		
	Guide/Retainer gray	341149	89536	341149	6		
	Shield, RCU	332445	89536	332445	1		
	Socket, IC, 16-contact	267535	23880	TSA-2900-16W	2		
	Address matrix standard card	350074	89536	350074	1		
	Conn, recept	348201	00779	1-380737-0	1		

Option —02
50-to-400 Hz Power Input

602-1. GENERAL

602-2. The —02 Option permits the 5200A to be operated from any power source, of sufficient voltage, from any power source, of sufficient voltage, from 50 to 400 Hz. The option consists of a cooling fan and a capacitor. Installation consists of replacing the existing cooling fan, which is not rated for 400-Hz operation, with the Option —02 fan, then wiring the capacitor into the circuit. Installation (conversion) instructions accompany the option.

602-3. LIST OF REPLACEABLE PARTS

602-4. Table 602-1 lists the replaceable parts for the 400 Hz Power Input Option. Refer to Section 5 for an explanation of the columnar entries.

Table 602-1. 50 - 400 Hz Option (—02) Parts List

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	50 - 400 Hz Option (Factory Installed) 5200A—02						
	(Not Illustrated)						
	Fan (50 to 400 Hz)	404319	92702	Model BC2206F 2	1		
	Cap, mylar, 1 uF ±20%, 600V	105924	84411	JF-26	1		

Option —03
RCU Input Inverter

603-1. INTRODUCTION

603-1. The —03 Option electrically interfaces the RCU, which employs negative active logic, with a programming device which employs positive active logic. The RCU Input Inverter consists of a number of logic inverters mounted on a printed circuit board, an input connector, an output connector, all enclosed within a metal housing. The entire assembly inserts between the rear connector of the RCU and the remote interconnecting cable to invert all signals passing between the remote programming device and the RCU.

603-3. INSTALLATION

603-4. The RCU Input Inverter is installed on the rear connector of the RCU assembly, and is held in place by a pair of retaining screws which fasten to the rear panel of the 5200A. The interconnecting cable assembly connects to the exposed printed circuit board edge connector on the rear of the RCU Input Inverter, and is held in place by a pair of retaining screws.

603-5. THEORY OF OPERATION

603-6. The RCU Input Inverter is made up of a number of logic inverters, as shown in schematic diagram 5200A-1081. Each inverter accepts a logic 0 and yields a logic 1, or accepts a logic 1 and yields a logic 0. Sufficient inverters are included for all RCU inputs and outputs, from and to the remote programming device.

603-7. MAINTENANCE

603-8. There is no maintenance procedures for the RCU Input Inverter. Troubleshooting and performance checks can be performed by applying +5Vdc to pin 24, connecting ground to pin 16, and checking each individual inverter by alternately applying +5Vdc and ground to the input while observing the output for logic inversion. Refer to schematic diagram 5200A-1081 for connector pin assignment information.

603-9. LIST OF REPLACEABLE PARTS

603-10. Table 603-1 lists the replaceable parts for the RCU Input Inverter. Refer to Section 5 for an explanation of the columnar entries.

Table 603-1. RCU Input Signal Inverter Option (—03), Parts List

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART NO. OR TYPE	TOT QTY	REC QTY	USE CDE
	INVERTER ASSEMBLY (Field Installable Kit) 5200A—03K						
A13	**PCB Assembly, inverter (See end of list for breakdown)**						
J82, P82	Connector, card-edge, female, 43/86-pin	335281	05574	2VK43D/ 2-2 7321E	2		
	Housing 1, Inverter	351619	89536	351619	1		
	Housing 2, Inverter	351593	89536	351593	1		
A13	PCB assembly, inverter (Figure 8-20)	346239	89536	346239	1		
C1,C2	Cap, cer, 0.22 uF, ±20%, 50V	309849	72982	8131-050-651-224M	2		
U1 thru U11	IC, DTL, hex inverter	268367	04713	MC836P	11		

Option —05
IEEE-488 Interface

NOTE

Installation of the IEEE-488 Interface Assembly into the 5200A does not degrade the 5200A Analog performance. However, when control is exercised by a high speed controller, through the interface, significant high frequency noise may be coupled to the 5200A output through radiation and system ground loops. Since the noise encountered varies with the controller connected into the system, the user should determine the amount of noise in his system, if outputs of less than 100mV are anticipated.

605-1. INTRODUCTION

605-2. Option —05 is an IEEE-488 standard interface which uses the subsets SH1, AH1, T6, TE0, L4, LE0, SR1, RL0, PP0, DC2 and DT0. All programming of the instrument is based on a character-serial, seven-bit ASCII code. Any characters not included in the instruction set are ignored by the interface. Status may be requested and an alphanumeric coded response of the status obtained.

605-3. The 5200A will vary its output as commands are entered through a control device. In addition to the programmable output of both frequency and voltage, control can be exercised over the Phase Lock, Sensing, Mode (Operate/Standby), Response Line Feed Suppression, and Interrupt Enable. The instrument may be addressed to obtain a two character status response or serial polled for a one byte response.

605-4. SPECIFICATIONS

605-5. The specifications of the IEEE-488 Interface are: full remote programming of voltage magnitude, frequency, sensing (internal/external), phase lock, response line feed suppression and mode (operate/standby). The interface is directly compatible with IEEE Interface Standards. Data returned on request includes Status of the Local/Remote, Standby/Operate, Limits, Settling Time and Out of Range instruction. Selection of the Local/Remote mode can only be made from the Front Panel and there is no Front Panel indication of the instrument output.

605-6. INSTALLATION

605-7. The IEEE-488 Standard Interface, Option —05, may be ordered as a factory installed option or as a field installable kit. If ordered for field installation use the following procedure:

1. Remove power from the instrument, then remove the top outer and inner cover.
2. Remove the plate covering the remote access port on the rear panel.
3. If installed, remove the screened rear coverplate from the Interface Assembly.
4. If another remote control device is installed in the instrument remove it at this time.
5. Install the interface assembly into the slot (A11) reserved for Remote Control Units.
6. Place the screened rear cover plate over the interface connector and attach it to the rear panel and interface with the four screws provided.

605-8. OPERATING FEATURES

605-9. Installation of Option —05 in the instrument adds the Operator Switches shown in Figure 605-1. Switches A1 through A5 are used to control the local address of the Calibrator. They may be set to the binary equivalent of any number, 0 through 30, that the controller has assigned the 5200A for an address. The setting for number 31 (11111) is reserved for the "Unlisten" instruction. Place the switches to the left for a "1" and to the right for a "0" and set the interface address using the codes in Table 605-1.

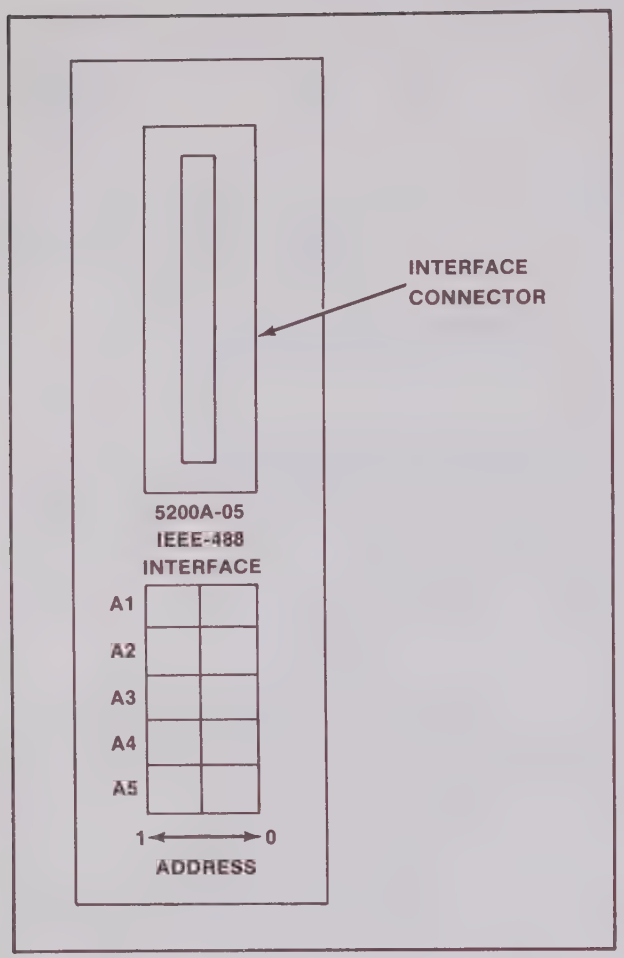


Figure 605-1. IEEE Address Switches

605-10. The address lines are five-bits of the seven-bit characters transmitted. The two high order bits of the seven lines are manipulated by the controller to differentiate between "Listen" (accept commands), "Talk" (send status), and commands to the interface.

605-11.OPERATING NOTES

605-12. Programming Instructions

605-13. Instructions can be either instrument control or output control. In addition, a status response may be obtained. An explanation and breakdown of these instructions and their respective codes are given in the following sub-paragraphs. All the codes with a brief explanation of each are listed in Table 605-2.

605-14. Instrument Control

605-15. These instructions are used to control the internal operation of the instrument. They perform such housekeeping tasks as clear, reset, suppress line feed and selection of the status that will generate an interrupt. The first instruction of any message must be preceded by the listen address assigned the instrument by the system controller. Each of these functions are explained below.

Table 605-1. Allowable Listen and Talk Addresses

DECIMAL	5 4 3 2 1 BINARY	ASCII CHARACTER	
		LISTEN	TALK
0	0 0 0 0 0	SP	@
1	0 0 0 0 1	!	A
2	0 0 0 1 0	"	B
3	0 0 0 1 1	#	C
4	0 0 1 0 0	$	D
5	0 0 1 0 1	%	E
6	0 0 1 1 0	&	F
7	0 0 1 1 1	'	G
8	0 1 0 0 0	(	H
9	0 1 0 0 1	)	I
10	0 1 0 1 0	*	J
11	0 1 0 1 1	+	K
12	0 1 1 0 0	,	L
13	0 1 1 0 1	–	M
14	0 1 1 1 0	.	N
15	0 1 1 1 1	/	O
16	1 0 0 0 0	0	P
17	1 0 0 0 1	1	Q
18	1 0 0 1 0	2	R
19	1 0 0 1 1	3	S
20	1 0 1 0 0	4	T
21	1 0 1 0 1	5	U
22	1 0 1 1 0	6	V
23	1 0 1 1 1	7	W
24	1 1 0 0 0	8	X
25	1 1 0 0 1	9	Y
26	1 1 0 1 0	:	Z
27	1 1 0 1 1	;	[
28	1 1 1 0 0	<	\
29	1 1 1 0 1	=	]
30	1 1 1 1 0	>	^

605-16. CLEAR

605-17. The character "C" clears from the storage buffer any instruction, of two or more characters, that has not had the last character entered.

605-18. RESET

605-19. The character "*" resets the instrument to the initialize state, which is:

1. 100μV selected on the 1mV range.
2. 1kHz selected on the 1kHz range.
3. Standby
4. Remote

Table 605-2. Programming Instructions

INSTRUCTION	EXPLANATION
C	Clears incomplete instruction
*	Resets and initializes instrument
J	Suppresses automatic line feed in response
I1-I7	Enables selected interrupt circuits
0-9	Numerics for programming voltage or frequency
V	Selects voltage specified by preceding numerics
H	Selects frequency specified by preceding numerics
E	Number following is exponent of 10 for preceding numerics
S	Selects Standby Mode
N	Selects Operate Mode
F0	Disables Phases lock
F1	Enables Phase lock
X0	Selects Internal Sensing
X1	Selects External Sensing

5. Internal Sense
6. Phase Lock Off
7. Line feeds enabled

605-20. SUPPRESS LINE FEED

605-21. The character "J" suppresses the automatic line feed in the status response message. To override the suppression program the Reset instruction described above.

605-22. INTERRUPT ENABLE

605-23. The character "I" followed by a numeric between 0 and 7 selects the state, or states, that enable the Interrupt circuits. The numerics define which status bits will generate the interrupt or service request (SRQ). Refer to Table 605-3 for an explanation of the numeric codes.

Table 605-3. Interrupt Codes

NUMERIC	STATUS BIT ENABLED		
	READY	OUT OF RANGE	LIMIT
0	No	No	No
1	No	No	Yes
2	No	Yes	No
3	No	Yes	Yes
4	Yes	No	No
5	Yes	No	Yes
6	Yes	Yes	No
7	Yes	Yes	Yes

605-24. Output Control

605-25. These instructions program and control the output of the instrument. They select the output voltage magnitude and frequency, and select the operating mode and conditions.

605-26. OUTPUT VOLTAGE AND FREQUENCY

605-27. The output voltage and frequency magnitude is programmed by entering the numerics for the value of magnitude desired, including the character "E" for the exponent of ten, if required, followed by "V" for Volts or "H" for Hertz. Examples of voltage and frequency instructions are given in Table 605-4.

Table 605-4. Voltage and Frequency Instructions

INSTRUCTION	REQUIREMENT
1.23V400H	1.23Volts at 400 Hertz
57E-3V1E3H or 057V1000H	57mV at 1 kHz
1E6H	1MHz, Voltage remains the same
1000V60H or 1E3V60H	1000 Volts at 60 Hertz
178.34V or 1.7834E2V	178.34 Volts, frequency remains the same

605-28. OPERATING MODE

605-29. The instrument is placed in OPERATE by programming the character "N" and returned to STANDBY with the character "S".

605-30. PHASE LOCK AND SENSING INSTRUCTIONS

605-31. Phase lock is enabled with the character set "F1" and disabled with "F0". Internal Sensing is selected with the character set "X0" and External Sensing with "X1".

605-32. Status Response

605-33. The message returned for a status response varies with the state of the Serial Poll. When Serial Poll is enabled and the interface is addressed as a talker a single status byte, as shown in Table 605-5., is returned. If serial poll is disabled a two digit message, as shown in Table 605-6., is returned.

Table 605-5. Serial Poll Status Byte

BIT	FUNCTION PRESENT WHEN: HIGH	LOW
1 (LSB)	Limit	Not Limited
2	Standby	Operate
3	Local	Remote
4	Out of Range	In Range
5	Settling	Not Settling
6	Not Used	Not Used
7	SRQ	No SRQ
8 (MSB)	Not Used	Not Used

605-34. THEORY OF OPERATION

605-35. The theory of operations for the IEEE-488 Interface is given in the following paragraphs on a block diagram level. The description includes an explanation of the operation of the interface in both the listen and talk modes since the calibrator is capable of both listening (accepting commands to change voltage, frequency and status) and talking (transmitting status information) to the bus. The calibrator is assigned, through the interface, a five bit address, which is the five low order bits of an ASCII character. The two high order bits determine whether it is to be a talk or listen address. Refer to Table 605-1 for the addresses available. The address 11111 is reserved for the "unlisten" and the "untalk" commands which prevent the counter from misunderstanding the information on the bus and talking or listening to itself. The block diagram of the interface used in the discussion is found in Figure 605-2.

605-37. Listen Mode

605-38. To operate in the Listen Mode, the pre-selected address must be on the Data Lines and the REN and ATN command lines active. This action, followed by active DAV and RFD signals, sets control flip-flops in the Data Decoders and Control Storage, preparing the interface microprocessor to accept instructions from the controller. After the data has been accepted, the DAC lines becomes active, inactivating ATN and DAV. The last action results in the DAC signal returning to inactive so that the interface is now ready to accept instruction.

605-39. Starting an instruction requires the ASCII code for the desired instruction on the data lines with ATN inactive and RFD active. The Controller drives DAV active to start the Handshake sequence. Once the data has been accepted in the microprocessor, the DAC signal goes active to complete the Handshake sequence. The microprocessor acts on the instruction, transforms it into the digital format required and outputs the instruction to the counter, passing through the digital-to-analog converter or stored pending a complete instruction, if required.

605-40. Talk Mode

605-41. The Talk Mode requires the ATN signal active and the correct address, just as the Listen Mode, to differentiate between it and an instruction. The start of the Handshake sequence latches the command into the Data Decoders and Control Storage for transfer to the microprocessor. Once the Handshake sequence is complete, the interface is in the Talk mode and can begin transmitting data to the Controller.

605-42. After the addressing has been completed, the microprocessor accepts the data on the lines from the couter and outputs it through Data Storage to the Data I/F Transceivers and Controller. After completion, dependent upon the mode selected, it will transmit either a single character or double character message, as determined by the serial poll status.

605-43. MAINTENANCE

605-44. Refer to the General Maintenance portion of Section 4 and the Installation portion of this procedure for instructions of removing and cleaning the pcb.

Table 605-6. Status Message, Serial Poll Disabled

	FIRST DIGIT			SECOND DIGIT		
BIT	LOCAL	STANDBY	LIMIT	BIT	SETTLING	OUT OF RANGE
0	No	No	No	0	No	No
1	No	No	Yes	1	No	Yes
2	No	Yes	No	2	Yes	No
3	No	Ues	Yes	3	Yes	Yes
4	Yes	No	No			
5	Yes	No	Yes			
6	Yes	Yes	No			
7	Yes	Yes	Yes			

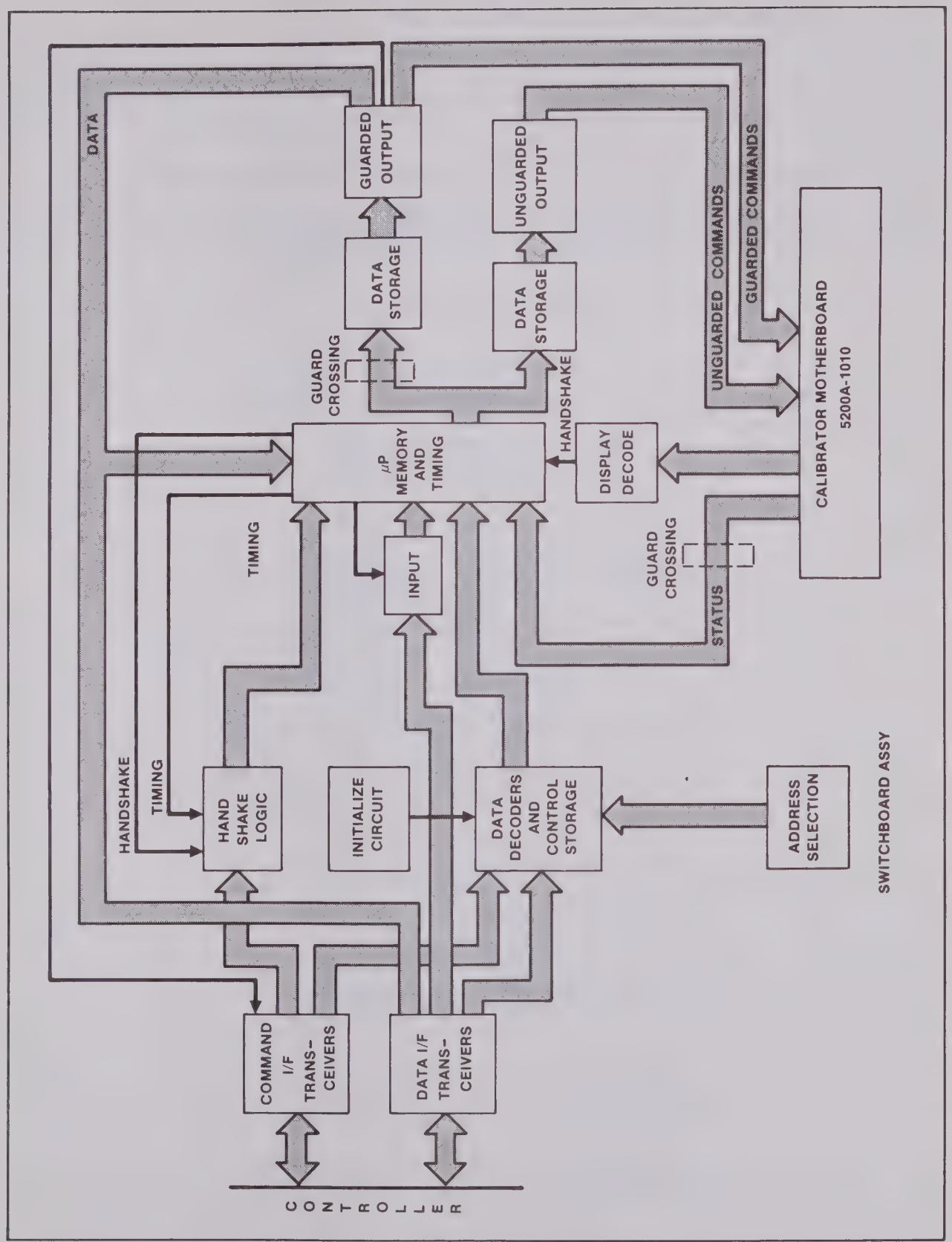


Figure 605-2. IEEE Interface Block Diagram

605-45. PERFORMANCE TEST

605-46. Connect a Voltmeter and Frequency Counter to the 5200A Output, then program the instruction set, verifying the 5200A has the proper output and response on the MODE, PHASE LOCK and SENSE indicators.

605-47. CALIBRATION

605-48. There is no calibration required for the IEEE-488 Interface Assembly

605-49. THROUBLESHOOTING

605-50. Troubleshooting for the 5200A Option —05 IEEE interface consists of the tabular flow chart in Table 605-7. When a step on the flow chart is completed, check for a decision transfer. If no decision is required, perform the next step of the table in sequence.

605-51. LIST OF REPLACEABLE PARTS

605-52. A list of replaceable parts for the IEEE-488 Interface Option begins with Table 605-8. Refer to Section 5 for an explanation of the columnar entries.

Table 605-7. Troubleshooting

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
	NOTE High and Low logic levels called out during this table are standard TTL signals levels of >2.4V (high) and ≤ 0.8V (low) and can be checked with an oscilloscope or logic tester.		
1	Prepare the 5200A for the test by selecting 100 μV at 1 kHz, External Sense, Phase Lock, Operate and Remote.		
2	Program the applicable "listen" address and the reset instruction "*".		
3	Did the 5200A go to Standby, Internal Sense, Phase Lock OFF and 100 μV at 1 kHz?	9	4
4	Did at least one, but not all of the originally selected states change with the reset?	9	5
5	Check for MLA at U34-35 to insure the interface has been properly addressed and can accept the instruction.		
6	Is the Signal High?	8	7
7	Verify that ATN is low at the input, then check the transceivers (U73/74) addressing circuits, handshake circuitry, and the listen flip-flop (U55). Repairs required then resume at Step 1.		
8	Check the microprocessor; the logic input, e.g. REMOTE and its associated circuits, then repair as required and resume at Step 1.		
9	Program the instruction "N" followed by "S" while observing the front panel.		
10	Did the OPER indicator illuminate, then extinguish, and the STDBY indicator extinguish, then illuminate?	12	11
11	Check U7-12 for a low with "N" entered and high with "S". While the keyswitch is held depressed check at the inputs if U23 and U73/U74 for the applicable ASCII code. Repair as required then resume at Step 9.		
	NOTE Due to the speed of the microprocessor individual codes are not recognizable on the bus lines until they are entered into a latching device.		
12	Program the instruction "F1" followed by "F0" while observing the front panel.		
13	Did the PHASE LOCK ON indicator illuminate then extinguish?	15	14
14	Check U5-12 for a low with "F1" entered and high with "F0". While the key switches are held depressed, check at the inputs of U23 and U73/U74 for the applicable ASCII code. Repair as required then resume at Step 12.		
15	Program the instruction "X1" followed by "X0" while observing the front panel.		
16	Did the EXT SENSE indicator illuminate, then extinguish, and the INT SENSE indicator extinguish then illuminate?	18	17
17	Check U4-12 for a low with "X1" entered and high with "X0". While the key switches are held depressed, check at the inputs, of U23 and U73/U74 for the applicable ASCII code. Repair as required then resume at Step. 15.		

Table 605-7. Troubleshooting (Cont'd.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
	NOTE Outputs within the voltage group include pin 5 of U4, U5, U6 and U7, and pins 4, 5, 6, 7 and 9 of U24, U25, U26 and U27. In tests of voltage programming a state will be given for some portion of the group and the remainder should be in the opposite state for that particular instruction.		
18	Program the instruction "111.111E-6V"		
19	Are pins U7-5, U27-4, U27-5, U27-6, U27-7 and U27-9 low, with the remaining pins of the voltage group high?	21	20
20	Check the decoders U7 and U27, and their inputs from U34. If the outputs are partially correct check the entry applicable to that output by holding down the key and checking at U23 and U73/U74. Repair as required then resume at Step 18.		
21	Program the instruction "222.222E-6V".		
22	Are pins U6-5, U26-4, U26-6, U26-7 and U26-9 low, with the remaining pins of the voltage group high?	24	23
23	Check the decoders U6 and U26, and their inputs from U34. If the outputs are partially correct check the input to U34 for the applicable entry. Repair as required then resume at Step 21.		
24	Program the instruction "444.444E-6V".		
25	Are pins U5-5, U25-4, U25-5, U25-6, U25-7 and U25-9 low, with the remaining pins of the voltage group high?	27	26
26	Check the decoders U5 and U25 and their inputs from U34. If the outputs are partially correct check the input to U34 for the applicable entry. Repair as required then resume at Step 24.		
27	Program the instruction "888.888E-6V".		
28	Are pins U4-5, U24-4, U24-5, U24-6, U24-7 and U24-9 low, with the remaining pins of the voltage group high?	30	29
29	Check the decoders U4 and U24, and their inputs from U34. If the outputs are partially correct check the input to U34 for the applicable entry. Repair as required then resume at Step 27.		
	NOTE Outputs within the frequency group include pins 7, 9, 10 and 11 of U4, U5, U6 and U7. In tests of frequency programming a state will be given for some portion of the group and the remainder should be in the opposite state for that particular instruction.		
30	Program the instruction "11.11H".		
31	Are pins U7-7, U7-9, U7-10 and U7-11 low, with the remaining pins of the frequency group high?	33	32
32	Check the decoder U7, the microprocessor U34 and its inputs. Repair as required then resume at Step 30.		
33	Program the instruction "22.22H".		
34	Are pins U6-7, U6-9, U6-10 and U6-11 low, with the remaining pins of the frequency group high?	36	35

Table 605-7. Troubleshooting (Cont'd.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
35	Check the decoder U6, the microprocessor U34 and its inputs. Repair as required then resume at Step 33.		
36	Program the instruction "44.44H".		
37	Are pins U5-7, U5-9, U5-10 and U5-11 low, with the remaining pins of the frequency group high?	39	38
38	Check the decoder U5, the microprocessor U34 and its inputs. Repair as required then resume at Step 36.		
39	Program the instruction "88.88H".		
40	Are pins U4-7, U4-9, U4-10 and U4-11 low, with the remaining pins of the frequency group high?	42	41
41	Check deocder U4, the microprocessor U34 and its inputs. Repair as required then resume at Step 39.		
42	Program the following instructions and check the points listed for the correct logic level at the voltage range selected.		
	Instructions / U5-4 / U6-4 / U7-4 1E-3V / High / High / Low 1E-2V / High / Low / High 1E-1V / High / Low / Low 1V / Low / High / High 10V / Low / High / Low 100V / Low / Low / High 1000V / Low / Low / Low		
43	Are the logic levels correct for the voltage range selected?	45	44
44	Check the decoders U5, U6 and U7, and the microprocessor U34. Repair as required then resume at Step 42.		
45	Program the following instructions and check the points listed for the correct logic level at the frequency range selected.		
	Instruction / U5-6 / U6-6 / U7-6 100H / High / High / High 1E3H / High / High / Low 1E4H / High / Low / High 1E5H / High / Low / Low 1E6H / Low / High / High		
46	Are the logic levels correct for the frequency range selected?	48	47
47	Check the decoders U5, U6 and U7, and the microprocessor U34. Repair as required then resume at Step 45.		
48	Program the instruction required by the controller in use for Interface Clear (IFC).		

Table 605-7. Troubleshooting (Cont'd.)

STEP NO.	ACTION	Go to the step number given for correct response	
		YES	NO
	NOTE At this time the IFC resets only the listen (MLA) flip-flop. It would also reset the talk (MTA) and Serial Poll (SPM) flip-flops if they had been set.		
49	Is there a low logic level at U55-3 and a high at U55-2?	51	50
50	Check for an input at U21-10 and a reset at U55-10. Repair as required then program the instruments listen address verify the U55-3 was sit high, and resume at Step 48.		
51	Enable the Serial Poll mode with the instruction required by the controller in use.		
52	Is there a high logic level at U54-5?	54	53
53	Check U54 and its input logic. Repair as required then resume at Step 51.		
54	Program the talk address of the instrument.		
55	Did the instrument respond with a one character status message containing the correct information?	57	56
56	Check for a high logic level at U55-5, check the microprocessor U34 and U73/U74. Repair as required then resume at Step 54.		
57	Disable the Serial Poll mode with the instruction required by the controller in use.		
58	Is there a low logic level at U54-5.	60	59
59	Check U54 and its input logic. Repair as required then resume at Step 57.		
60	Program the talk address of the instrument.		
61	Did the instrument respond with a two character status message containing the correct information?	63	62
62	Check U55, the microprocessor U34, and U73/U74. Repair as required then resume at Step 60.		
63	Troubleshooting of the IEEE option is now complete.		

Table 605-8 IEEE-488 Interface Option –05

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
A11	IEEE INTERFACE (I/F) ASSEMBLY OPTION –05 (Figure: 8-22)						
	Factory Installed	5200A-05					
	Field Installabel Kit	5200A-05K					
C1 thru C4, C65, C96 thru C99	Cap, Ta, 0.22 uF ±20%, 35V	161331	56289	196D225X 0035HA1	9		
C51	Cap, cer, 1200 pF ±10%, 500V	106732	71590	CF-122	1		
C71 thru C74	Cap, Ta, 10 uF ±20%, 20V	330662	56289	196D106X 0020KA1	4		
C75	Cap, Ta, 1.0 uF ±20%, 35V	161919	56289	196D105X 0035JA1	1		
C76, C77	Cap, mica, 22 pF ±5%, 500V	148551	72136	DM15C220J	2		
C91	Cap, polyester film, 0.10 uF ±10%, 100V	393439	73445	C280MAH/ A100K	1		
J1	Conn, 24 pin	408898	02660	57-20240-2	1		
L1, L2	Choke, 6-turn	320911	89536	320911	2		
Q1 thru Q20	Xstr, si, PNP	195974	04713	2N3906	20		
R1 thru R20	Res, car, dep, 10.0k ±5%, 1/4W	348839	80031	CR251-4-5 P10K	20		
R25, R26 R28, R55 thru R62	Res, car, dep, 180 ±5%, 1/4W	441436	80031	CR251-4-5 P180E	11		
R27	Res, car dep, 4.7k ±5%, 1/4W	348821	80031	CR251-4-5 p4K7	1		
R29, R70	Res, car dep, 2.2k ±5%, 1/4W	343400	80031	CR251-4-5 P2K2	2		
R51	Res, car dep, 100 ±5%, 1/4W	348771	80031	CR251-4-5 P100E	1		
R52 thru R54	Res, car dep, 51k ±5%, 1/4W	376434	80031	CR251-4-5 P51K	3		
R91	Res, car dep, 390 ±5%, 1/4W	441543	80031	CR251-4-5 P390E	1		
RN1	Res, network, 4.7k 1/4W	416834	89536	416834	1	1	

Table 605-8 IEEE-488 Interface Option –05 (cont)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
S1	Switch, DIL,	417766	00779	435470-4	1		
U1	IC, Dgtl, TTL, Tri-state, hex buffer	408146	12040	DM8095N	1	1	
U2, U21, U62, U75	IC, Dgtl, TTL, Hex Inverter, pos NAND gates	393058	01295	SN74LS04N	7	1	
U3	IC, Dgtl, TTL quad 2-input, pos NAND gates	292953	01295	SN7400N	1	1	
U4 thru U7, U24 thru U27	IC, Dgtl, 8-bit addressable latch	419242	01295	SN74LS259N	8	2	
U11, U12	Opto-isolator, logic drive	387076	29083	ILS-74	2	1	
U22, U23	IC, Dgtl, TTL, Lo-pwr Schottky, Tri-state octal buffer	429902	12040	DM81LS95N	2	1	
U33	IC, Dgtl, TTL, Lo-pwr Schottky, hex/quad, d-type flip-flop with clear	393215	01295	SN746S175N	1	1	
U34	IC, 8-bit micro-computer, with EPROM	454876	34649	8448-8C	1	1	
U51, U64, U68	IC, Dgtl, pos NOR gates with totem pole output	393041	01295	SN74LS02N	3	1	
U52, U54, U55, U61	IC, Dgtl, TTL, dual, J-K neg edge triggered flip-flop	393157	01295	SN74LS107N	4	1	
U53	IC, Dgtl, lo-pwr Schottky, dual D with clear & preset	393124	01295	SN74LS74N	1	1	
U56, U65 U76, U77	IC, Dgtl, TTL pos NAND gates, & Inverters with totem pole outputs	404889	01295	SN74LS30N	4	1	
U63	IC, Dgtl, TTL, quad 2-input pos AND gates, with totem pole outputs	393066	01295	SN74LS08N	1	1	
U66	IC, Dgtl, TTL, quad 2-input pos OR gates, with totem pole outputs	393108	01295	SN74LS32N	1	1	
U67	IC, Dgtl, TTL, quad 2-input pos NAND gates with totem pole outputs	393033	01295	SN74LS00N	1	1	
U71 thru U74	IC, Dgtl, quad interface bus transceiver	428649	04713	MC3446P	4	1	
V1	Crystal, 34 MHz, quartz	393322	89536	393322	1		
XS1	Socket, right angle, 20 pin IC	453068	51167	20-823-90C	1		
XU34	Socket, IC 40 pin	376244	91506	340-AG39D	1		

Table 605-8 IEEE-488 Interface Option –05 (concluded)

REF DESIG OR ITEM NO.	DESCRIPTION	FLUKE STOCK NO.	MFG FED SPLY CDE	MFG PART. NO. OR TYPE	TOT QTY	REC QTY	USE CDE
1	Fence	450155	89536	450155	1		
	Hardware:						
2	Screw, hex spacer	429472	89536	429472	2		
3	Washer, lock	111070	89536	111070	2		
4	Plate, adapter, rear	468652	89536	468652	1		
5	Tie, component, nylon	172080	06383	SST-1M	1		

Section 7
General Information

7-1. This section of the manual contains generalized user information as well as supplemental information to the List of Replaceable parts contained in Section 5. The following information is presented in this section:

List of Abbreviations
Federal Supply Codes for Manufacturers
Fluke Technical Service Centers — U.S. and Canada
Sales and Service Locations — International
Sales Representatives — U.S. and Canada

Table 7-1. LIST OF ABBREVIATIONS AND SYMBOLS

A or amp	ampere
ac	alternating current
af	audio frequency
a/d	analog-to-digital
assy	assembly
AWG	american wire gauge
B	bel
bcd	binary coded decimal
^{o}C	Celsius
cap	capacitor
ccw	counterclockwise
cer	ceramic
cermet	ceramic to metal(seal)
ckt	circuit
cm	centimeter
cmrr	common mode rejection ratio
comp	composition
cont	continue
crt	cathode-ray tube
cw	clockwise
d/a	digital-to-analog
dac	digital-to-analog converter
dB	decibel
dc	direct current
dmm	digital multimeter
dvm	digital voltmeter
elect	electrolytic
ext	external
F	farad
^{o}F	Fahrenheit
FET	Field-effect transistor
ff	flip-flop
freq	frequency
FSN	federal stock number
g	gram
G	giga (10^{9})
gd	guard
Ge	germanium
GHz	gigahertz
gmv	guaranteed minimum value
gnd	ground
H	henry
hd	heavy duty
hf	high frequency
Hz	hertz
IC	integrated circuit
if	intermediate frequency
in	inch(es)
intl	internal
I/O	input/output
k	kilo (10^{3})
kHz	kilohertz
kΩ	kilohm(s)
kV	kilovolt(s)
lf	low frequency
LED	light-emitting diode
LSB	least significant bit
LSD	least significant digit
M	mega (10^{6})
m	milli (10^{-3})
mA	milliampere(s)
max	maximum
mf	metal film
MHz	megahertz
min	minimum
mm	millimeter
ms	millisecond
MSB	most significant bit
MSD	most significant digit
MTBF	mean time between failures
MTTR	mean time to repair
mV	millivolt(s)
mv	multivibrator
MΩ	megohm(s)
n	nano (10^{-9})
na	not applicable
NC	normally closed
(–) or neg	negative
NO	normally open
ns	nanosecond
opnl ampl	operational amplifier
p	pico (10^{-12})
para	paragraph
pcb	printed circuit board
pF	picofarad
pn	part number
(+) or pos	positive
pot	potentiometer
p-p	peak-to-peak
ppm	parts per million
PROM	programmable read-only memory
psi	pound-force per square inch
RAM	random-access memory
rf	radio frequency
rms	root mean square
ROM	read-only memory
s or sec	second (time)
scope	oscilloscope
SH	shield
Si	silicon
serno	serial number
sr	shift register
Ta	tantalum
tb	terminal board
tc	temperature coefficient or temperature compensating
tcxo	temperature compensated crystal oscillator
tp	test point
u or μ	micro (10^{-6})
uhf	ultra high frequency
us or μs	microsecond(s) (10^{-6})
uut	unit under test
V	volt
v	voltage
var	variable
vco	voltage controlled oscillator
vhf	very high frequency
vlf	very low frequency
W	watt(s)
ww	wire wound
xfmr	transformer
xstr	transistor
xtal	crystal
xtlo	crystal oscillator
Ω	ohm(s)
μ	micro (10^{-6})

00213
Nytronics Comp. Group Inc.
Subsidiary of Nytronics Inc.
Formerly Sage Electronics
Rochester, New York

00327
Welwyn International, Inc.
Westlake, Ohio

00656
Aerovox Corp.
New Bedford, Massachusetts

00686
Film Capacitors, Inc.
Passaic, New Jersey

00779
AMP Inc.
Harrisberg, Pennsylvania

01121
Allen-Bradley Co.
Milwaukee, Wisconsin

01281
TRW Electronic Comp.
Semiconductor Operations
Lawndale, California

01295
Texas Instruments, Inc.
Semiconductor Group
Dallas, Texas

01537
Motorola Communications &
Electronics Inc.
Franklin Park, Illinois

01686
RCL Electronics Inc.
Manchester, New Hampshire

01730
Replaced by 73586

01884 - use 56289
Sprague Electric Co.
Dearborn Electronic Div.
Lockwood, Florida

02114
Ferroxcube Corp.
Saugerties, New York

02131
General Instrument Corp.
Harris ASW Div.
Westwood, Maine

02395
Rason Mfg. Co.
Brooklyn, New York

02533
Snelgrove, C.R. Co., Ltd.
Don Mills, Ontario, Canada
M3B 1M2

02606
Fenwal Labs
Div. of Travenal Labs.
Morton Grove, Illinois

02660
Bunker Ramo Corp., Conn Div.
Formerly Amphenol-Borg
Electric Corp.
Broadview, Illinois

02799
Areo Capacitors, Inc.
Chatsworth, California

03508
General Electric Co.
Semiconductor Products
Syracuse, New York

03614
Replaced by 71400

03651
Replaced by 44655

03797
Eldema Div.
Genisco Technology Corp.
Compton, California

03877
Transistron Electronic Corp.
Wakefield, Massachusetts

03888
KDI Pyrofilm Corp.
Whippany, New Jersey

03911
Clairex Electronics Div.
Clairex Corp.
Mt. Vernon, New York

03980
Muirhead Inc.
Mountainside, New Jersey

04009
Arrow Hart Inc.
Hartford, Connecticut

04062
Replaced by 72136

04202
Replaced by 81312

04217
Essex International Inc.
Wire & Cable Div.
Anaheim, California

04221
Aemco, Div. of
Midtex Inc.
Mankato, Minnesota

04222
AVX Ceramics Div.
AVX Corp.
Myrtle Beach, Florida

04423
Telonic Industries
Laguna Beach, California

04645
Replaced by 75376

04713
Motorola Inc. Semiconductor
Products
Phoenix, Arizona

04946
Standard Wire & Cable
Los Angeles, California

05082
Replaced by 94988

05236
Jonathan Mfg. Co.
Fullerton, California

05245
Components Corp. now
Corcom, Inc.
Chicago, Illinois

05277
Westinghouse Electric Corp.
Semiconductor Div.
Youngwood, Pennsylvania

05278
Replaced by 43543

05279
Southwest Machine &
Plastic Co.
Glendora, California

05397
Union Carbide Corp.
Materials Systems Div.
New York, New York

05571 - use 56289
Sprague Electric Co.
Pacific Div.
Los Angeles, California

05574
Viking Industries
Chatsworth, California

05704
Replaced by 16258

05820
Wakefield Engineering Inc.
Wakefield, Massachusetts

06001
General Electric Co.
Electronic Capacitor &
Battery Products Dept.
Columbia, South Carolina

06136
Replaced by 63743

06383
Panduit Corp.
Tinley Park, Illinois

06473
Bunker Ramo Corp.
Amphenol SAMS Div.
Chatsworth, California

06555
Beede Electrical Instrument Co.
Penacook, New Hampshire

06739
Electron Corp.
Littleton, Colorado

06743
Clevite Corp.
Cleveland, Ohio

06751
Components, Inc. Semcor Div.
Phoenix, Arizona

06860
Gould Automotive Div.
City of Industry, California

06961
Vernitron Corp., Piezo
Electric Div.
Formerly Clevite Corp., Piezo
Electric Div.
Bedford, Ohio

06980
Eimac Div.
Varian Associates
San Carlos, California

07047
Ross Milton, Co., The
South Hampton, Pennsylvania

07115
Replaced by 14674

07138
Westinghouse Electric Corp.,
Electronic Tube Division
Horsehead, New York

07233
TRW Electronic Components
Cinch Graphic
City of Industry, California

07256
Silicon Transistor Corp.
Div. of BBF Group Inc.
Chelmsford, MA

07261
Aumet Corp.
Culver City, California

07263
Fairchild Semiconductor
Div. of Fairchild Camera
& Instrument Corp.
Mountain View, California

07344
Bircher Co., Inc.
Rochester, New York

07597
Burndy Corp.
Tape/Cable Div.
Rochester, New York

07792
Lerma Engineering Corp.
Northampton, Massachusetts

07910
Teledyne Semiconductor
Formerly Continental Device
Hawthorne, California

07933 - use 49956
Raytheon Co.
Semiconductor Div. HQ
Mountain View, California

08225
Industro Transistor Corp.
Long Island City, New York

08261
Spectra Strip Corp.
Garden Grove, California

08530
Reliance Mica Corp.
Brooklyn, New York

08806
General Electric Co.
Miniature Lamp Products Dept.
Cleveland, Ohio

08863
Nylomatic Corp.
Norrisville, Pennsylvania

08988 - use 53085
Skottie Electronics Inc.
Archbald, Pennsylvania

09214
G.E. Co. Semi-Conductor
Products Dept.
Power Semi-Conductor
Products OPN Sec.
Auburn, New York

09353
C and K Components
Watertown, Massachusetts

09423
Scientific Components, Inc.
Santa Barbara, California

09922
Burndy Corp.
Norwalk, Connecticut

09969
Dale Electronics Inc.
Yankton, S. Dakota

10059
Barker Engineering Corp.
Formerly Amerace, Amerace
ESNA Corp.
Kenilworth, New Jersey

11236
CTS of Berne
Berne, Indiana

11237
CTS Keene Inc.
Paso Robles, California

11358
CBS Electronic Div.
Columbia Broadcasting System
Newburyport, MN

11403
Best Products Co.
Chicago, Illinois

11503
Keystone Columbia Inc.
Warren, Michigan

11532
Teledyne Relays
Hawthorne, California

11711
General Instrument Corp
Rectifier Division
Hickville, New York

11726
Qualidyne Corp.
Santa Clara, California

12014
Chicago Rivet & Machine Co.
Bellwood, Illinois

12040
National Semiconductor Corp.
Danburry, Connecticut

12060
Diodes, Inc.
Chatsworth, California

12136
Philadelphia Handle Co.
Camden, New Jersey

12300
Potter-Brumfield Division
AMF Canada LTD.
Guelph, Onatrio, Canada

12323
Presin Co., Inc.
Shelton, Connecticut

12327
Freeway Corp. formerly
Freeway Washer & Stamping Co.
Cleveland, Ohio

12443
Budd Co. The, Polychem Products
Plastic Products Div.
Bridgeport, PA

12615
U.S. Terminals Inc.
Cincinnati, Ohio

12617
Hamlin Inc.
Lake Mills, Wisconsin

12697
Clarostat Mfg. Co.
Dover, New Hampshire

12749
James Electronics
Chicago, Illinois

12856
Micrometals
Sierra Madre, California

12954
Dickson Electronics Corp.
Scottsdale, Arizona

12969
Unitrode Corp.
Watertown, Massachusetts

13103
Thermalloy Co., Inc.
Dallas, Texas

13327
Solitron Devices Inc.
Tappan, New York

13511
Amphenol Cadre Div.
Bunker-Ramo Corp.
Los Gatos, California

13606 - use 56289
Sprague Electric Co.
Transistor Div.
Concord, New Hampshire

13839
Replaced by 23732

14099
Semtech Corp.
Newbury Park, California

14140
Edison Electronic Div.
Mc Gray-Edison Co.
Manchester, New Hampshire

14193
Cal-R-Inc. formerly
California Resistor, Corp.
Santa Monica, California

14298
American Components, Inc.
an Insilco Co.
Conshohocken, Pennsylvania

14655
Cornell-Dublier Electronics
Division of Federal Pacific
Electric Co. Govt. Control Dept.
Newark, New Jersey

14752
Electro Cube Inc.
San Gabriel, California

14869
Replaced by 96853

14936
General Instrument Corp.
Semi Conductor Products Group
Hicksville, New York

15636
Elec-Trol Inc.
Saugus, California

15801
Fenwal Electronics Inc.
Div. of Kidde Walter and Co., Inc.
Framingham, Massachusetts

15818
Teledyne Semiconductors, formerly
Amelco Semiconductor
Mountain View, California

15849
Litton Systems Inc. Useco Div.
formerly Useco Inc.
Van Nuys, California

15898
International Business
Machines Corp.
Essex Junction, Vermont

15909
Replaced by 14140

16258
Space-Lok Inc.
Burbank, California

16299
Corning Glass
Electronic Components Div.
Raleigh, North Carolina

16332
Replaced by 28478

16473
Cambridge Scientific Ind.
Div. of Chemed Corporation
Cambridge, Maryland

16742
Paramount Plastics Fabricators, Inc.
Downey, California

16758
Delco Electronics
Div. of General Motors Corp.
Kokomo, Indiana

17001
Replaced by 71468

17069
Circuit Structures Lab.
Burbank, California

17338
High Pressure Eng. Co., Inc.
Oklahoma City, Oklahoma

17545
Atlantic Semiconductors, Inc.
Asbury Park, New Jersey

17856
Siliconix, Inc.
Santa Clara, California

17870
Replaced by 14140

18178
Vactec Inc.
Maryland Heights, Missouri

18324
Signetics Corp.
Sunnyvale, California

18612
Vishay Resistor Products Div.
Vishay Intertechnology Inc.
Malvern, Pennsylvania

18736
Voltronics Corp.
Hanover, New Jersey

18927
G T E Sylvania Inc.
Precision Material Group
Parts Division
Titusville, Pennsylvania

19451
Perine Machinery & Supply Co.
Seattle, Washington

19701
Electro-Midland Corp.
Mepco-Electra Inc.
Mineral Wells, Texas

20584
Enochs Mfg. Inc.
Indianapolis, Indiana

20891
Self-Organizing Systems, Inc.
Dallas, Texas

21604
Buckeye Stamping Co.
Columbus, Ohio

21845
Solitron Devices Inc.
Transistor Division
Riveria Beach, Florida

22767
ITT Semiconductors
Palo Alto, California

23050
Product Comp. Corp.
Mount Vernon, New York

23732
Tracor Inc.
Rockville, Maryland

23880
Stanford Applied Engrng.
Santa Clara, California

23936
Pamotor Div., Wm. J. Purdy Co.
Burlingame, California

24248
Replaced by 94222

24355
Analog Devices Inc.
Norwood, Massachusetts

24655
General Radio
Concord, Massachusetts

24759
Lenox-Fugle Electronics Inc.
South Plainfield, New Jersey

25088
Siemen Corp.
Isilen, New Jersey

25403
Amperex Electronic Corp.
Semiconductor &
Micro-Circuits Div.
Slatersville, Rhode Island

27014
National Semiconductor Corp.
Santa Clara, California

27264
Molex Products
Downers Grove, Illinois

28213
Minnesota Mining & Mfg. Co.
Consumer Products Div.
St. Paul, Minnesota

28425
Serv-/-Link formerly
Bohannan Industries
Fort Worth, Texas

28478
Deltrol Controls Div.
Deltrol Corporation
Milwaukee, Wisconsin

28480
Hewlett Packard Co. Corporate H.Q.
Palo Alto, California

28520
Heyman Mfg. Co.
Kenilworth, New Jersey

29083
Monsanto, Co., Inc.
Santa Clara, California

29604
Stackpole Components Co.
Raleigh, North Carolina

30148
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Replaced by 58474

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Elco Corp.
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91737 - use 71468
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91934
Miller Electric Co., Inc.
Div of Aunet
Woonsocket, Rhode Island

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Alpha Wire Corp.
Elizabeth, New Jersey

93332
Sylvania Electric Products
Semiconductor Products Div.
Woburn, Massachusetts

94145
Replaced by 49956

94154 - use 94988
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Tung-Sol Div.
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Replaced by 98278

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97945
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97966
Replaced by 11358

98094
Replaced by 49956

98159
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98291
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Mamaroneck, New York

98388
Royal Industries
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San Diego, California

98743
Replaced by 12749

98925
Replaced by 14433

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99392
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99779 - use 29587
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Tel. (612) 884-4336

MISSOURI
Kansas City
CCI Sales Group
John Fluke Mfg. Co., Inc.
4406 Chouteau Traffic Way
Zip: 64117
Tel. (816) 454-5836

St. Louis
CCI Sales Group
John Fluke Mfg. Co., Inc.
300 Brookes Dr.
Suite 100
Hazelwood, MO
Zip: 63042
Tel. (314) 731-3388

NEW JERSEY
Newark
SBM Sales Group
John Fluke Mfg. Co., Inc.
460 Colfax Avenue
Clifton, NJ
Zip: 07013
Tel. (710-989-7059

NEW MEXICO
Albuquerque
Barnhill Three, Inc.
1410-D Wyoming N.E.
Zip: 87112
Tel. (201) 299-7658

NEW YORK
Rochester
SBM Sales Group
John Fluke Mfg. Co., Inc.
4515 Culver Road
Zip: 14622
Tel. (716) 266-1400

NORTH CAROLINA
Greensboro
BCS Associates, Inc.
P.O. Box 9619
1310 Beaman Place
Zip: 27408
Tel. (919) 273-1918

OHIO
Cleveland
WKM Associates, Inc.
16141 Puritas Ave.
Zip: 44135
Tel. (216) 267-0445

OREGON
Beaverton
Showalter Instruments Inc.
3800 S.W. Cecar Hills Blvd.
Suite 160
Zip: 97005
Tel. (503) 644-9164

PENNSYLVANIA
Philadelphia
Mid-Atlantic Sales Group
John Fluke Mfg. Co., Inc.
Suite H
1010 West 8th Street
King of Prussia, PA
Zip: 19406
Tel. (215) 265-4040

Pittsburgh
WKM Associates, Inc.
90 Clairton Blvd.
Zip: 15236
Tel. (412) 892-2953

TEXAS
Austin
Barnhill Two, Inc.
111 W. Anderson Lane
Suite 221
Zip: 78752
Tel. (512) 451-0217

Dallas
Barnhill Two, Inc.
1101 Executive Dr. East
Suite 110
Richardson, TX
Zip: 75081
Tel. (214) 231-2573

Houston
Barnhill Two, Inc.
1606 Hempstead Highway
Suite 132
Zip: 77092
Tel. (713) 688-9971

VIRGINIA
Williamsburg
BCS Associates, Inc.
107 Rich Neck Road
Zip: 23185
Tel. (804) 877-4053

WASHINGTON
Richland
Showalter Instruments, Inc.
1210 Mahan
Zip: 99352
Tel. (509) 943-5288

Seattle
Showalter Instruments, Inc.
1521 130th N.E.
Bellevue, WA
Zip: 98005
Tel. (206) 455-4922

CANADA

ALBERTA
Calgary
Allan Crawford Assoc., Ltd.
3829 12th Street N.E.
Zip: T2E 6M5
Tel. (403) 276-9658

BRITISH COLUMBIA
North Vancouver
Allan Crawford Assoc., Ltd.
116 E. Third St.
Zip: V7I 1E6
Tel. (604) 980-4831

NOVA SCOTIA
Halifax
Allan Crawford Assoc., Ltd.
800 Windmill Rd.
Burnside Industrial Park
Dartmouth, NS
Zip: B3B 1L1
Tel. (902) 469-7865

ONTARIO
Toronto
Allan Crawford Assoc., Ltd.
6503 Northam Drive
Mississauga, Ont
Zip: L4V 1J5
Tel. (416) 678-1500

Ottawa
Allan Crawford Assoc., Ltd.
1299 Richmond Road
Zip: K2B 7Y4
Tel. (613) 829-9651

QUEBEC
Montreal
Allan Crawford Assoc., Ltd.
1330 Marie Victorian Blvd. E.
Longueuil, P.Q. J4G 1A2
Tel. (514) 670-1212

All of the above Fluke Sales Offices carry local stocks of low-cost Digital Multimeters (Models 8000A, 8030A, 8040A), Counters (Model 1900A), Digital Thermometers (Models 2160A, 2170A, 2165A, 2175A) and the Universal Temperature Probe (Model 80T-150). These same products are available from the following distributors:

Brownell Electronics
Atlanta, GA (404)762-5181
Charlotte, NC (704) 394-4341
Memphis, TN (901) 323-8554
Nashville, TN (615) 889-8230
Orlando, FL (305) 843-6770
Mobile, AL (205) 479-5405

The Mancib Company
Boston, MA (617) 272-9450
Middletown, CT (203) 346-6646

Elmar Electronics
San Francisco, CA (415) 961-3611
Denver, CO (303) 287-9611

Pioneer-Standard
Cleveland, OH (216) 587-3600
Dayton, OH (513) 236-9900
Indianapolis, IN (317) 849-7300
Pittsburgh, PA (412) 782-2300
Detroit, MI (313) 525-1800

Liberty Electronics
El Segundo, CA (213) 322-8100
San Diego, CA (714) 565-9171
Phoenix, AZ (602) 257-1272
Seattle, WA (206) 763-8200
Albuquerque, NM (505) 299-8293
Beaverton, OR (503) 644-4783

Section 8
Schematic Diagrams

FIGURE NO.	NAME	DRAWING NO.	PAGE
8-1	A2 Motherboard PCB Assembly	5200A-1010	8-3
8-2	A3 Switchboard Assembly Component Location	5200A-1011	8-4
8-3	A3 Switchboard PCB Assembly	5200A-1011	8-5
8-4	A5 Power Supply Assembly Component Location	5200A-1020	8-6
8-5	A5 Power Supply Assembly	5200A-1020	8-7
8-6	A6 Attenuator Assembly Component Location	5200A-1030	8-8
8-7	A6 Attenuator PCB Assembly (2 sheets)	5200A-1030	8-9
8-8	A7 Power Amplifier Assembly Component Location	5200A-1040	8-12
8-9	A7 Power Amplifier PCB Assembly	5200A-1040	8-13
8-10	A8 AC-DC Converter Assembly Component Location	5200A-1050	8-14
8-11	A8 AC-DC Converter PCB Assembly (3 sheets)	5200A-1050	8-15
8-12	A9 Oscillator Control Assembly Component Location	5200A-1060	8-20
8-13	A9 Oscillator Control PCB Assembly (3 sheets)	5200A-1060	8-21
8-14	A10 Oscillator Assembly Component Location	5200A-1070	8-26
8-15	A10 Oscillator PCB Assembly (4 sheets)	5200A-1070	8-27
8-16	All Remote Control Unit Assembly Component Location	5200A-1080	8-34
8-17	All Remote Control Unit PCB Assembly (2 sheets)	5200A-1080	8-35
8-18	A12 Reference Supply Assembly Component Location	5200A-1090	8-38
8-19	A12 Reference Supply PCB Assembly (2 sheets)	5200A-1090	8-39
8-20	Inverter Assembly Component Location	5200A-1081	8-42
8-21	Inverter PCB Assembly	5200A-1081	8-43
8-22	A11 IEEE Interface (I/F) Assembly Component Location	5200A-1686	8-44
8-23	A11 IEEE Interface (I/F) Assembly (2 Sheets)	5200A-1086	8-45

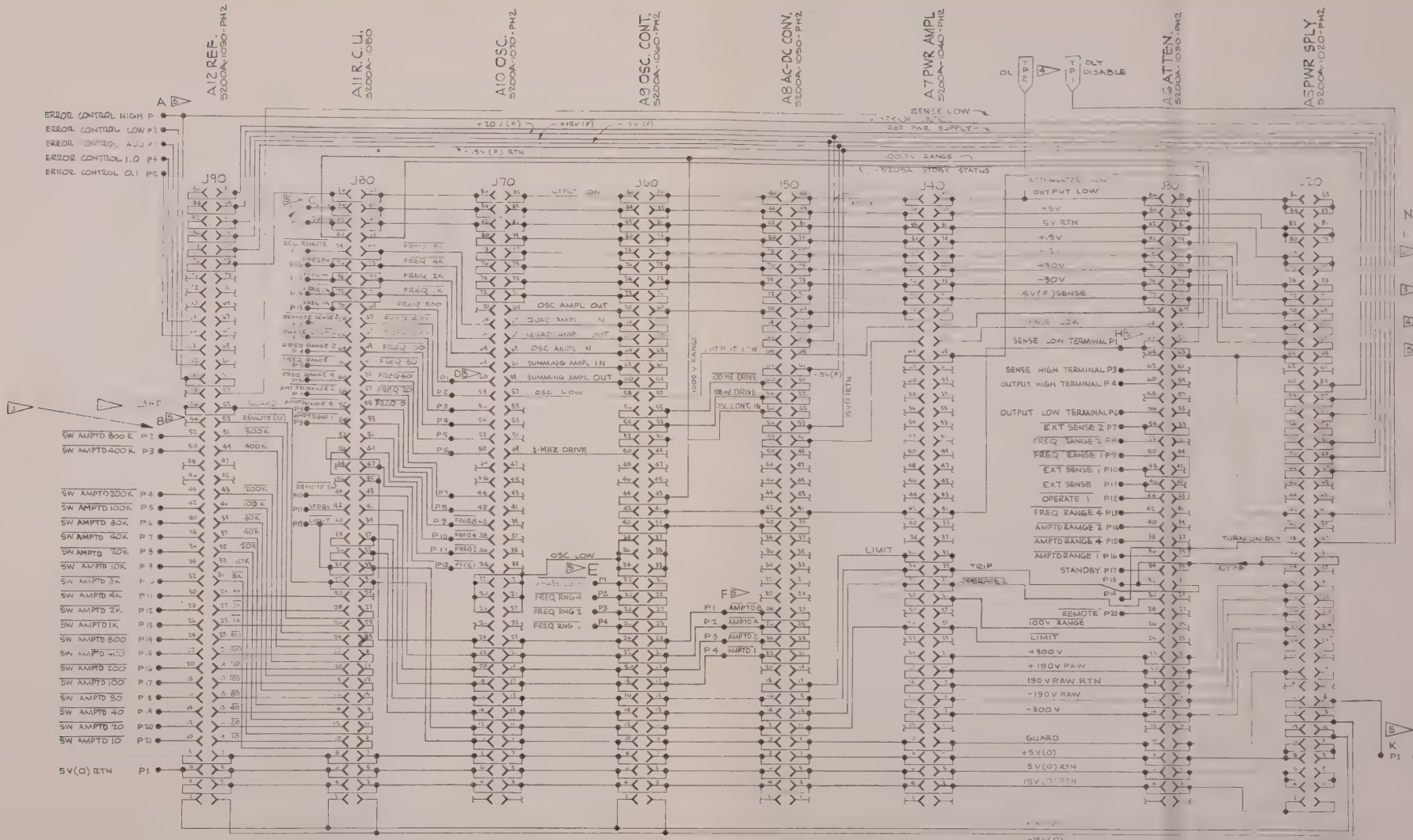


FIGURE 8-1 A2 MOTHERBOARD PCB ASSEMBLY (5200A-1010)

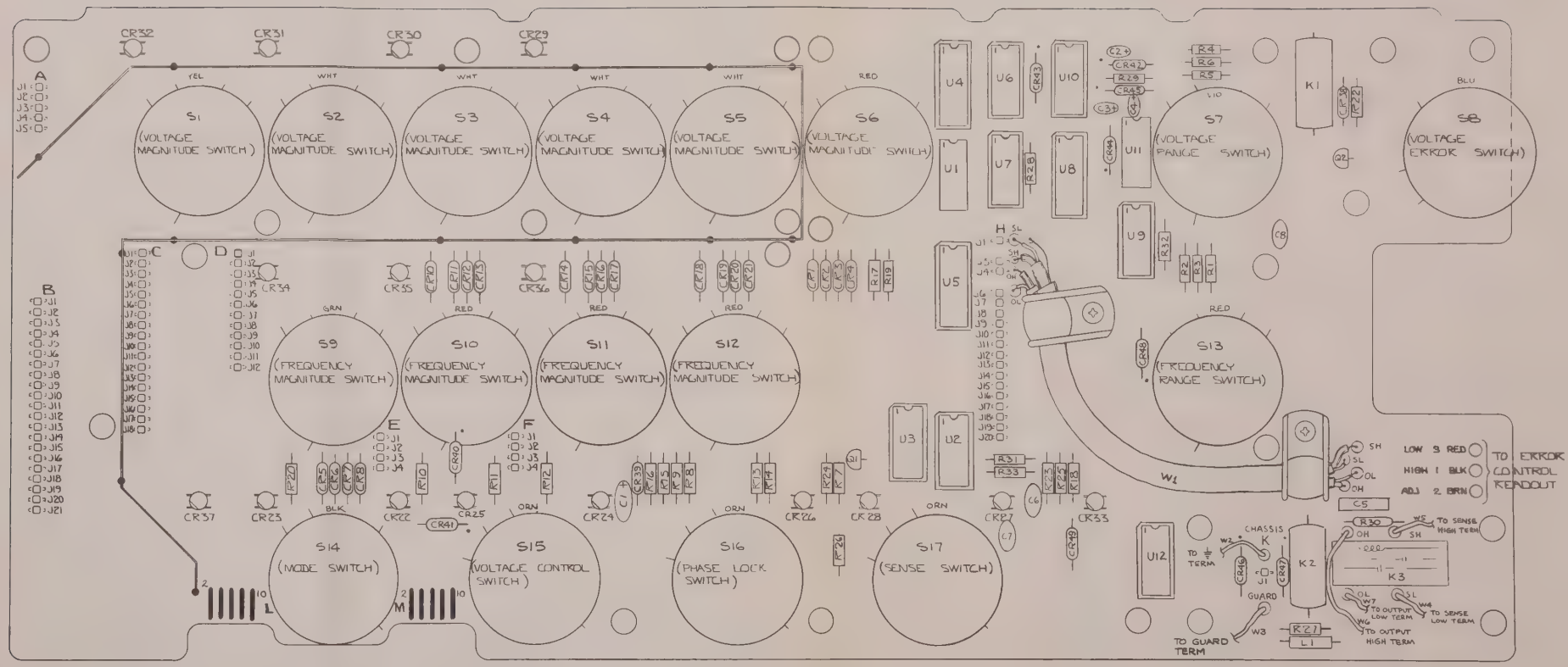


FIGURE 8-2. A3 SWITCHBOARD ASSEMBLY COMPONENT LOCATION (5200A-1011)

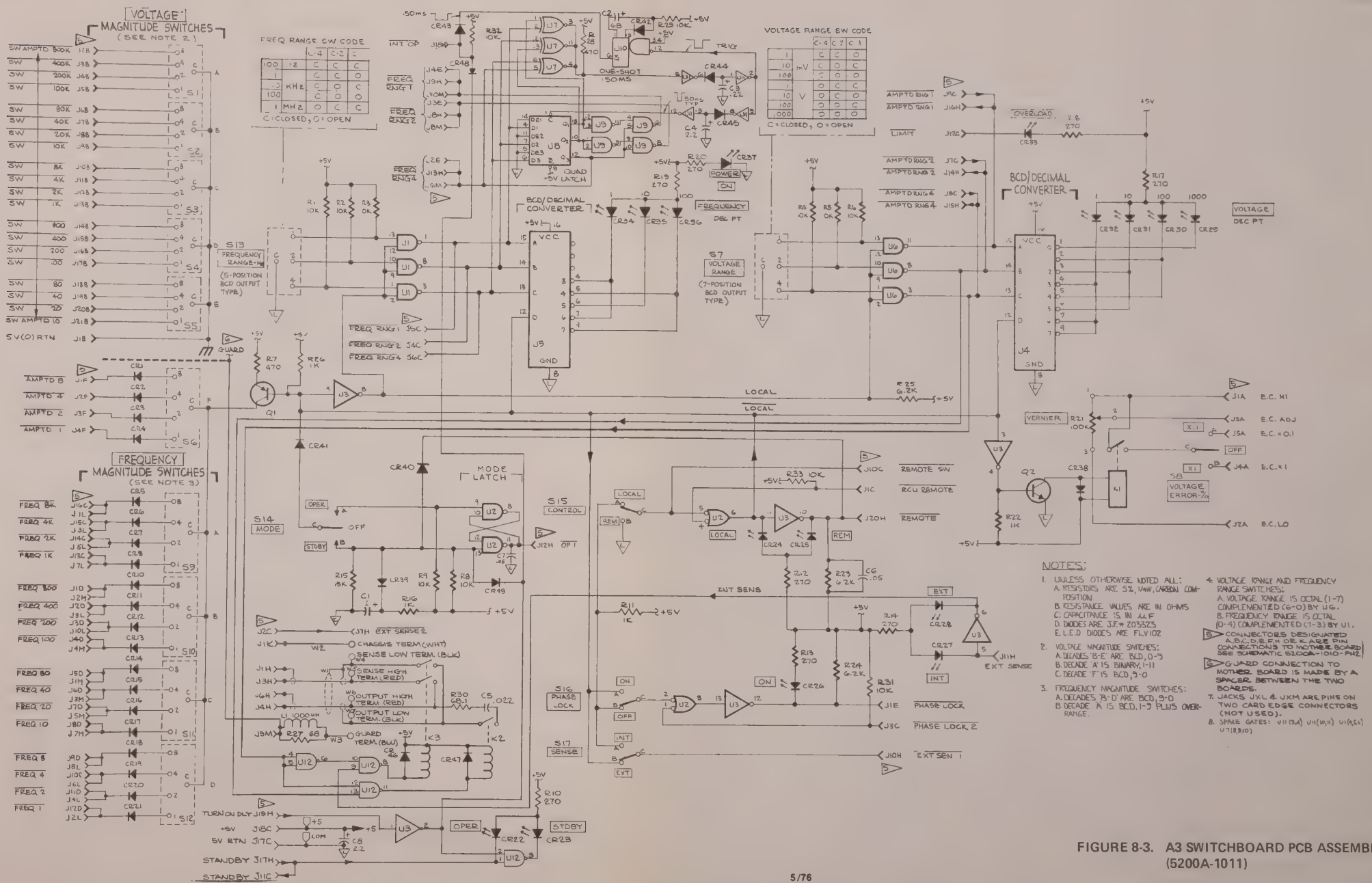
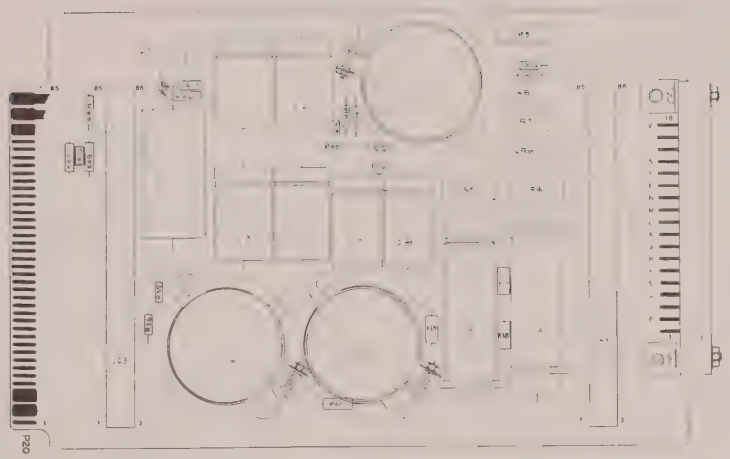
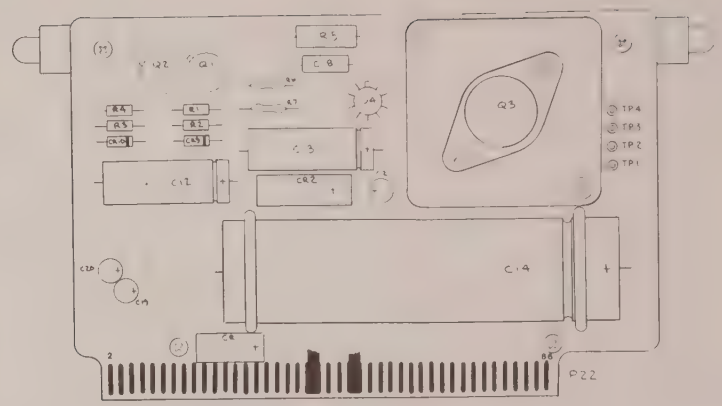

VOLTAGE MAGNITUDE SWITCHES (SEE NOTE 2.)
FREQUENCY MAGNITUDE SWITCHES (SEE NOTE 3)
FREQ RANGE SW CODE
VOLTAGE RANGE SW CODE
C=CLOSED, O=OPEN
S13 FREQUENCY RANGE-HZ (5-POSITION BCD OUTPUT TYPE)
S7 VOLTAGE RANGE (7-POSITION BCD OUTPUT TYPE)
BCD/DECIMAL CONVERTER
QUAD +5V LATCH
ONE-SHOT .50MS
MODE LATCH
S14 MODE
S15 CONTROL
S16 PHASE LOCK
S17 SENSE
OVERLOAD
LIMIT
POWER ON
FREQUENCY DEC PT
VOLTAGE DEC PT
VERNIER
VOLTAGE ERROR-%
LOCAL
REMOTE SW
RCU REMOTE
REMOTE
PHASE LOCK
PHASE LOCK 2
EXT SENSE
EXT SEN 1
INT SENS
GUARD
TURN ON DLY J1BH
STANDBY J1JH
STANDBY J1IC
NOTES:
1. UNLESS OTHERWISE NOTED ALL:
A. RESISTORS ARE 5%, 1/4W, CARBON COMPOSITION
B. RESISTANCE VALUES ARE IN OHMS
C. CAPACITANCE 'S IN µF
D. DIODES ARE J.F.D. ZD5323
E. L.E.D. DIODES ARE FLV102
2. VOLTAGE MAGNITUDE SWITCHES:
A. DECADES 'B-E' ARE BCD, 0-9
B. DECADE 'A' IS BINARY, 1-11
C. DECADE 'F' IS BCD, 9-0
3. FREQUENCY MAGNITUDE SWITCHES:
A. DECADES 'B-D' ARE BCD, 9-0
B. DECADE 'A' IS BCD, 1-7 PLUS OVER-RANGE.
4. VOLTAGE RANGE AND FREQUENCY RANGE SWITCHES:
A. VOLTAGE RANGE IS OCTAL (1-7) COMPLEMENTED (6-0) BY U6.
B. FREQUENCY RANGE IS OCTAL (0-4) COMPLEMENTED (7-3) BY U1.
5. CONNECTORS DESIGNATED A,B,C,D,E,F,H, OR K ARE DIN CONNECTIONS TO MOTHER BOARD SEE SCHEMATIC 6200A-1010-PH2.
6. GUARD CONNECTION TO MOTHER BOARD IS MADE BY A SPACER BETWEEN THE TWO BOARDS.
7. JACKS J1L & J1XM ARE PINS ON TWO CARD EDGE CONNECTORS (NOT USED).
8. SPARE GATES: U11 (3,4) U11 (10,11) U11 (6,5) U7 (8,9,10)

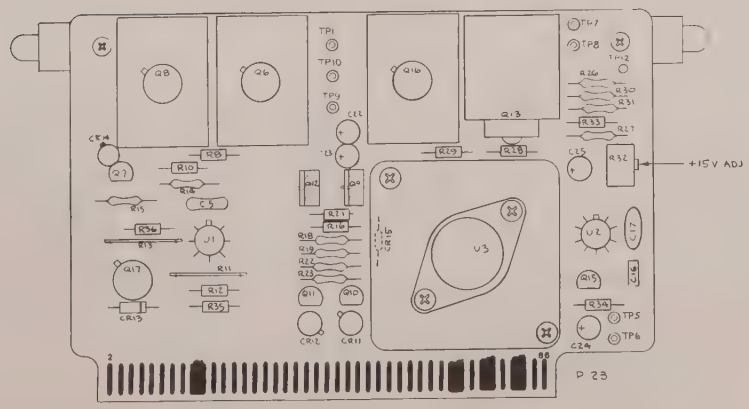
FIGURE 8-3. A3 SWITCHBOARD PCB ASSEMBLY (5200A-1011)



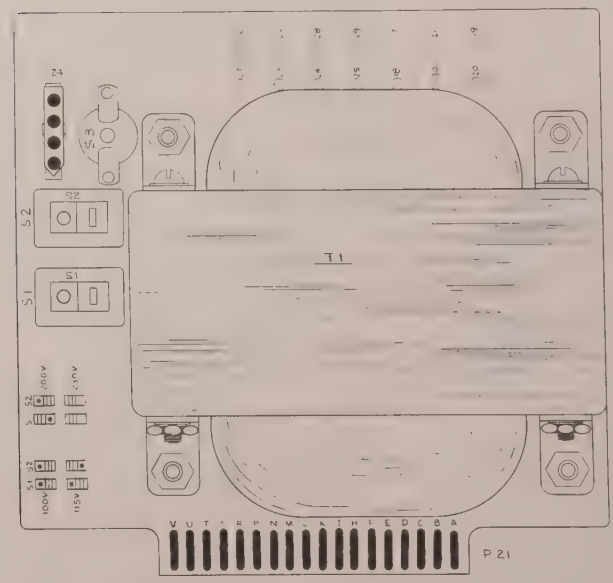
a. POWER SUPPLY MOTHER PCB ASSEMBLY



b. POWER SUPPLY PCB SUB ASSEMBLY



c. REGULATOR PCB ASSEMBLY



d. TRANSFORMER PCB SUB ASSEMBLY

FIGURE 8-4 A5 POWER SUPPLY ASSEMBLY COMPONENT LOCATION (5200A-1020)

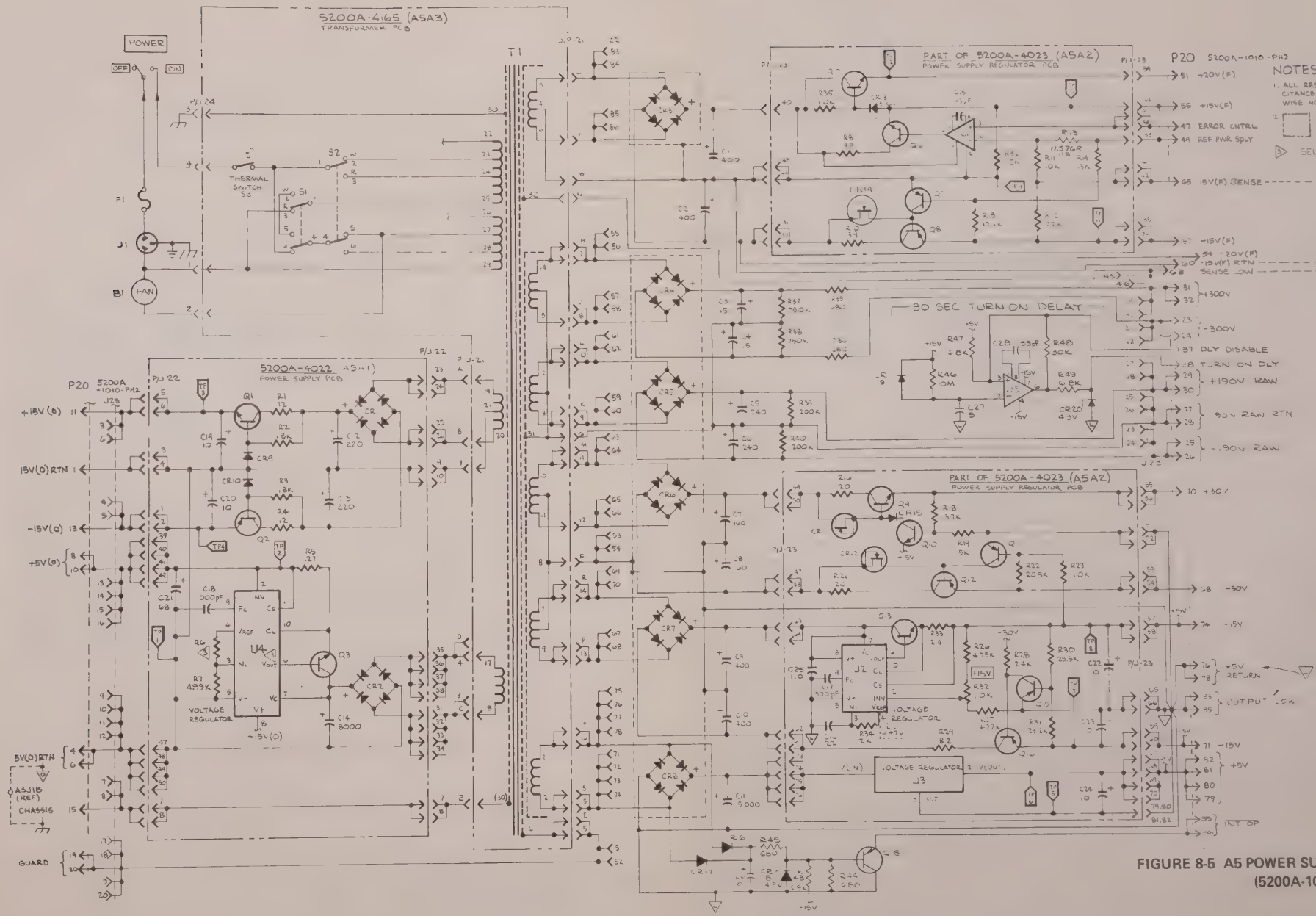


FIGURE 8-5 A5 POWER SUPPLY ASSEMBLY (5200A-1020)

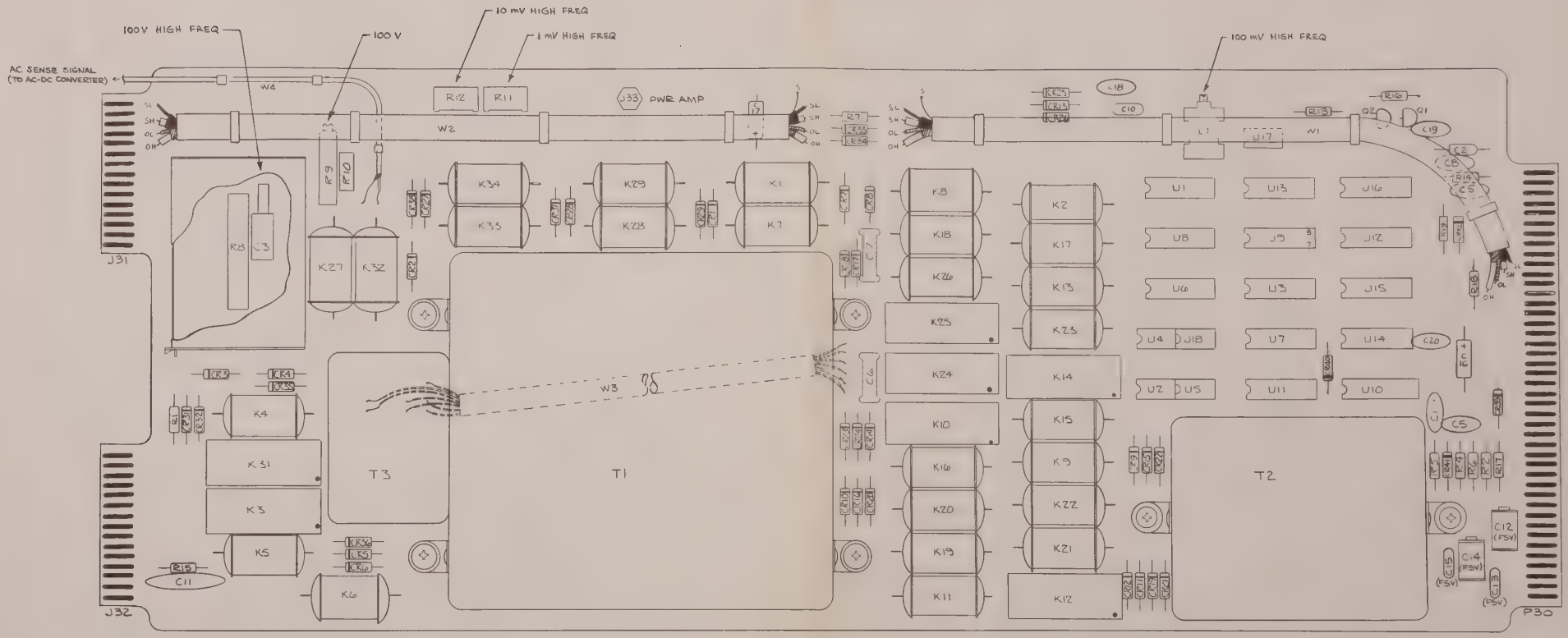
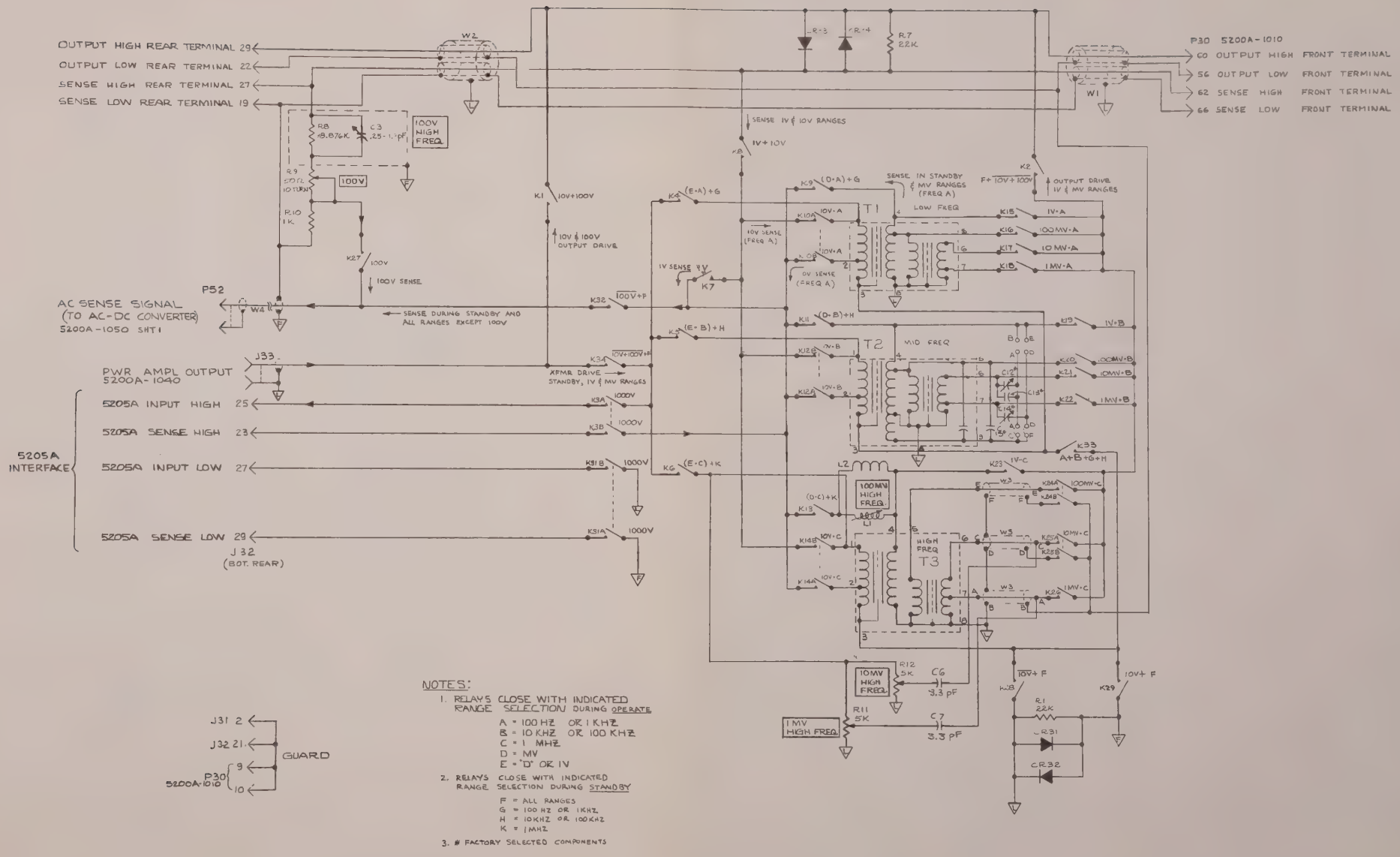


FIGURE 8-6. A6 ATTENUATOR ASSEMBLY COMPONENT LOCATION (5200A-1030)

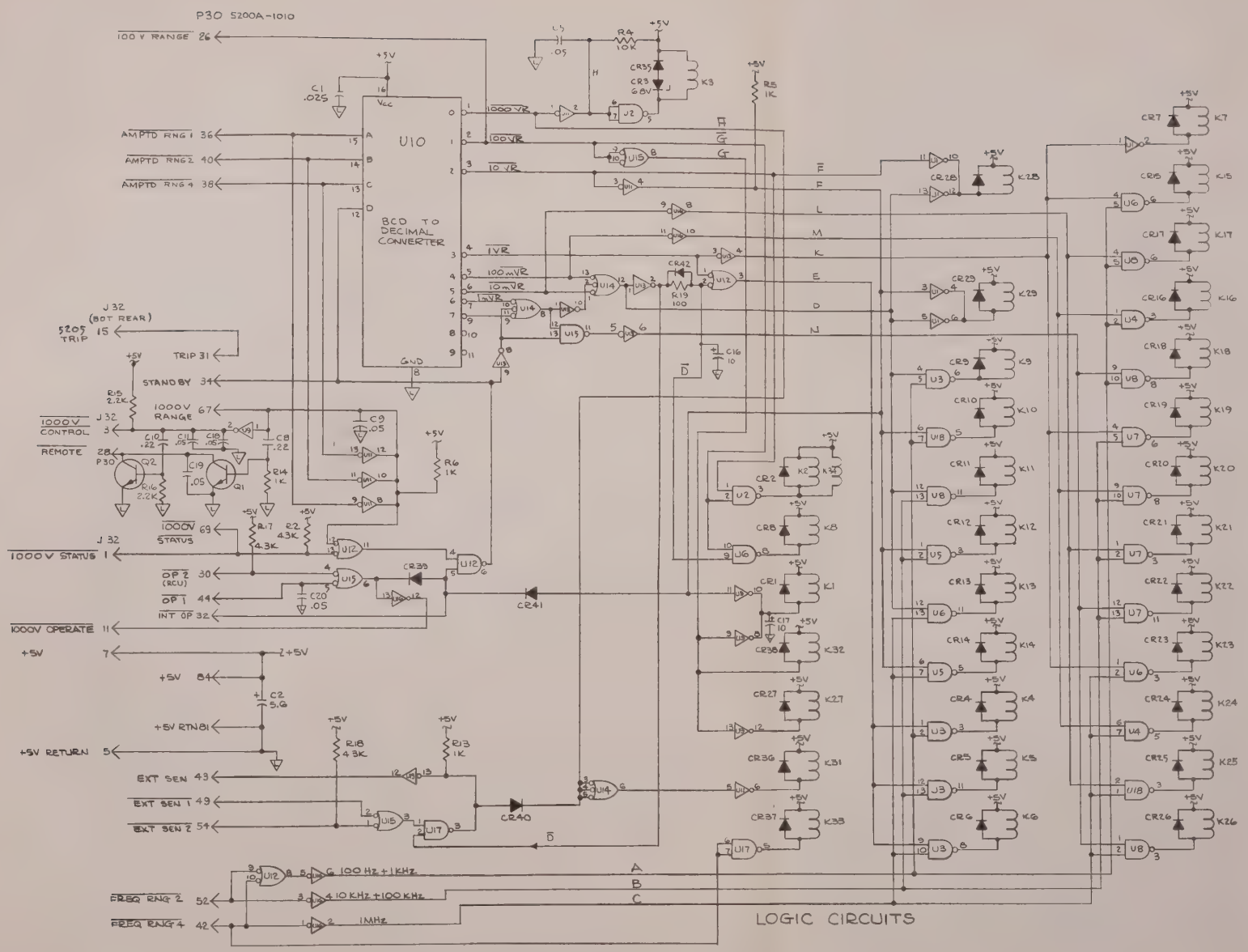


NOTES:

1. RELAYS CLOSE WITH INDICATED RANGE SELECTION DURING OPERATE
   - A = 100 HZ OR 1 KHZ
   - B = 10 KHZ OR 100 KHZ
   - C = 1 MHZ
   - D = MV
   - E = "D" OR 1V
2. RELAYS CLOSE WITH INDICATED RANGE SELECTION DURING STANDBY
   - F = ALL RANGES
   - G = 100 HZ OR 1KHZ
   - H = 10KHZ OR 100KHZ
   - K = 1MHZ
3. # FACTORY SELECTED COMPONENTS

ATTENUATION & SENSING CIRCUITS

FIGURE 8-7. (1 of 2) A6 ATTENUATOR PCB ASSY. (5200A-1030)



NOTES

1. IC

SN7400	U12
SN7404	U13, U16
SN7410	U14
SN7416	U1, U9, U11
SN7438	U3, U6, U7, U8
SN7442	U10
SN75452P	U2, U5, U4, U17, U18
SN7437	U15

2. UNLESS OTHERWISE SPECIFIED:
   ALL CAPACITORS IN μF
   ALL RESISTORS 1/4 W, C.C 5%, IN OHMS

3. SPARE GATES:

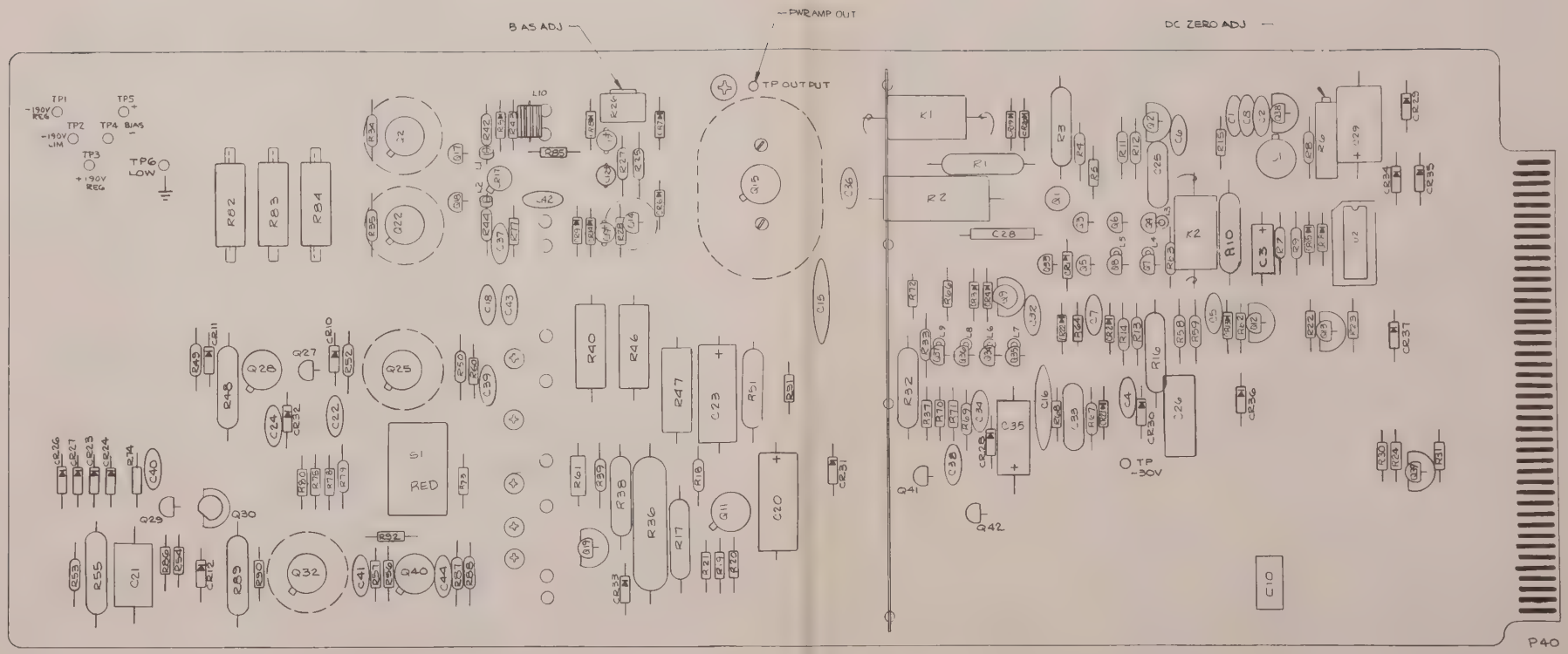
RANGE			INPUT PIN 38 (R4)	40 (R2)	36 (R1)
	1	mV	1	1	0
	10		1	0	1
	100		1	0	0
	1	V	0	1	1
	10		0	1	0
	100		0	0	1
	1000		0	0	0

RANGE			INPUT PIN 42 (R4)	52 (R2)	REF (R1)
	100	HZ	1	1	1
	1		1	1	0
	10	kHz	1	0	1
	100		1	0	0
	1	MHz	0	1	1

1 = HIGH = POS = TRUE = +2.0 TO +5.0V
0 = LOW = NEG = FALSE = 0.0 TO +0.8V

SEE SHT 1 FOR REV.

FIGURE 8-7. (2 of 2) A6 ATTENUATOR PCB ASSY. (5200A-1030)


BIAS ADJ
PWR AMP OUT
DC ZERO ADJ
TP OUTPUT
TP1
-190V REG
TP2
-190V LIM
TP3
+190V REG
TP4 BIAS
TP5
TP6 LOW
R62
R63
R64
Q22
L10
L11
L12
L13
L14
L15
L16
L17
L18
L19
L20
L21
L22
L23
L24
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R1
R2
R3
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R11
R12
R13
R14
R15
R16
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R18
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R79
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R81
R82
R83
R84
C1
C2
C3
C4
C5
C6
C7
C8
C9
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C27
C28
C29
C30
C31
C32
C33
C34
C35
C36
C37
C38
C39
C40

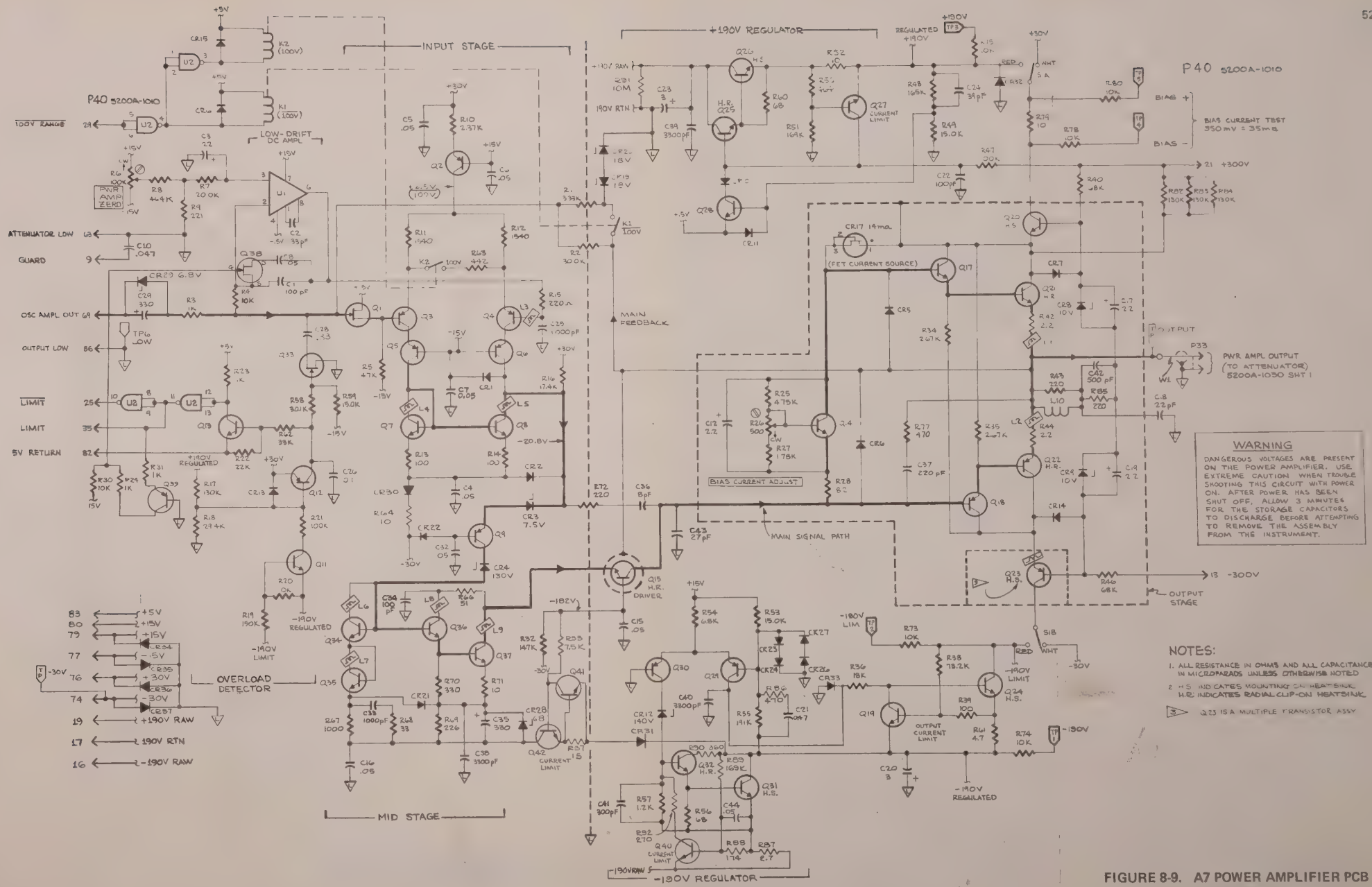

INPUT STAGE
+190V REGULATOR
P40 5200A-1010
LOW-DRIFT DC AMPL
MAIN FEEDBACK
MAIN SIGNAL PATH
BIAS CURRENT ADJUST
(FET CURRENT SOURCE)
OVERLOAD DETECTOR
MID STAGE
-190V REGULATOR
OUTPUT STAGE
P33
PWR AMPL OUTPUT (TO ATTENUATOR) 5200A-1030 SHT 1
BIAS CURRENT TEST 350mV = 35mA
WARNING
DANGEROUS VOLTAGES ARE PRESENT ON THE POWER AMPLIFIER. USE EXTREME CAUTION WHEN TROUBLE SHOOTING THIS CIRCUIT WITH POWER ON. AFTER POWER HAS BEEN SHUT OFF, ALLOW 3 MINUTES FOR THE STORAGE CAPACITORS TO DISCHARGE BEFORE ATTEMPTING TO REMOVE THE ASSEMBLY FROM THE INSTRUMENT.
NOTES:
1. ALL RESISTANCE IN OHMS AND ALL CAPACITANCE IN MICROFARADS UNLESS OTHERWISE NOTED
2. H.S. INDICATES MOUNTING ON HEATSINK. H.R. INDICATES RADIAL CLIP-ON HEATSINK.
3. Q23 IS A MULTIPLE TRANSISTOR ASSY

FIGURE 8-9. A7 POWER AMPLIFIER PCB ASSY. (5200A-1040).

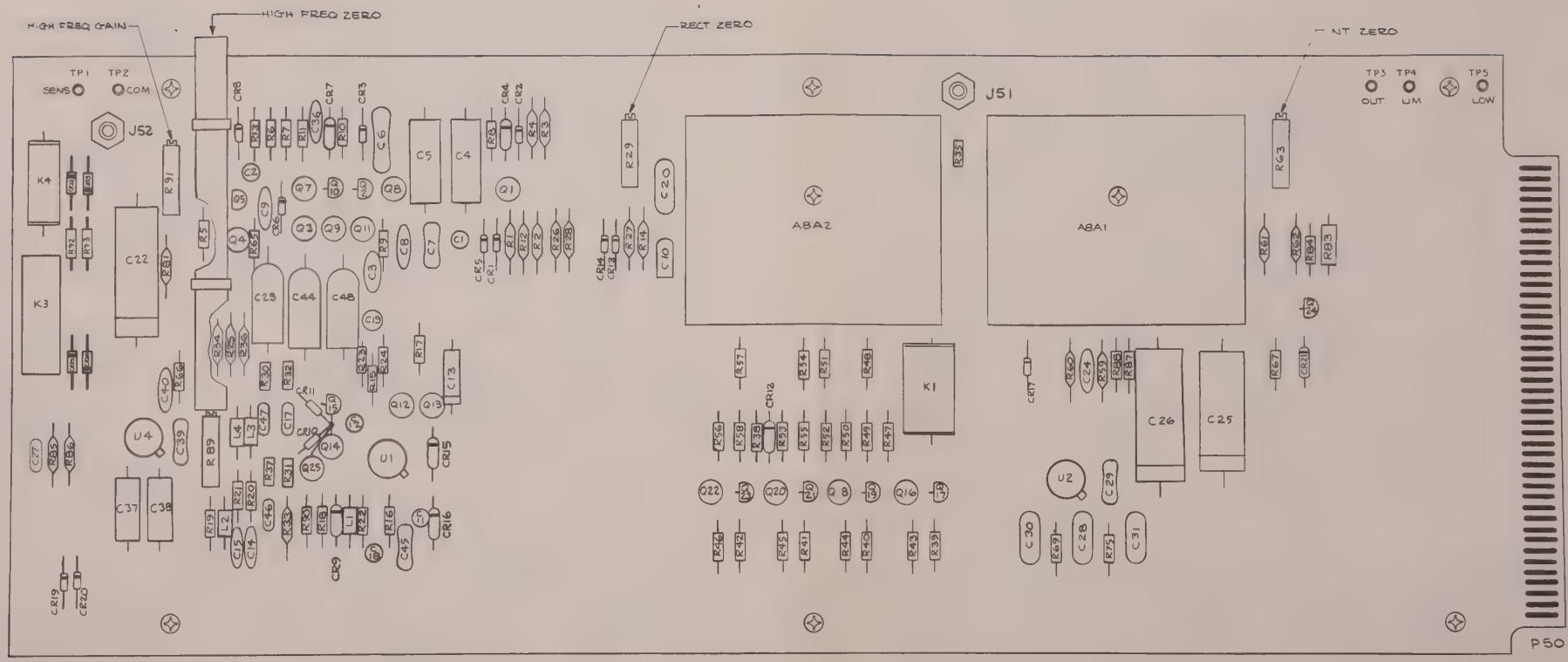


FIGURE 8-10. A8 AC-DC CONVERTER ASSEMBLY COMPONENT LOCATION (5200A-1050)

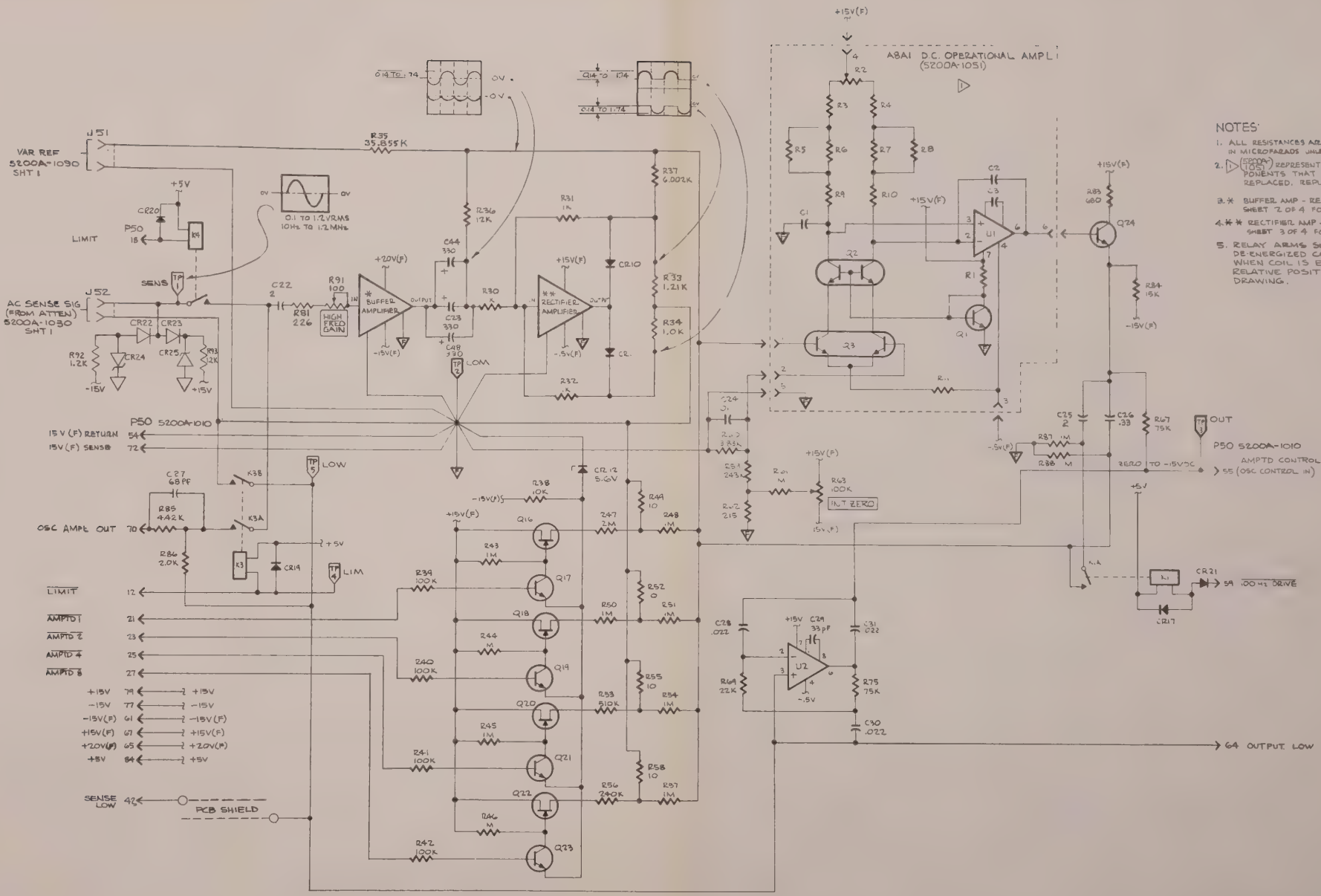
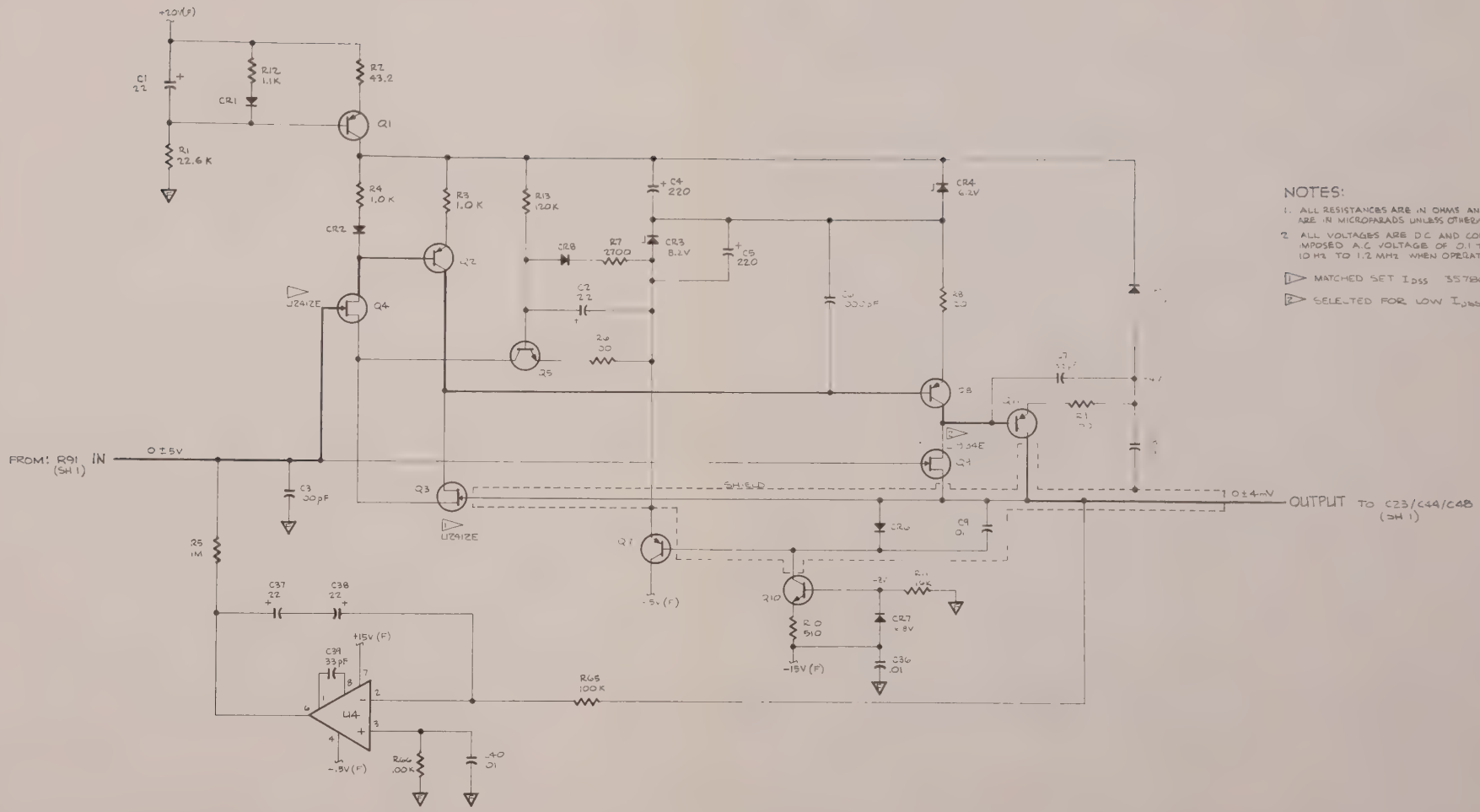

A8A1 D.C. OPERATIONAL AMPL (5200A-1051)
NOTES:
1. ALL RESISTANCES ARE IN OHMS AND ALL CAPACITANCE IN MICROFARADS UNLESS OTHERWISE NOTED.
2. (5200A-105) REPRESENTS A DISCRETE SET OF COMPONENTS THAT CANNOT BE INDIVIDUALLY REPLACED. REPLACE THE ENTIRE ASSEMBLY.
3. * BUFFER AMP - REFER TO DWG 5200A-1080 SHEET 2 OF 4 FOR SCHEMATIC DIAGRAM.
4. ** RECTIFIER AMP - REFER TO DWG 5200A-1080 SHEET 3 OF 4 FOR SCHEMATIC DIAGRAM
5. RELAY ARMS SHOWN IN POSITION FOR DE-ENERGIZED COIL. ARMS MOVE DOWNWARD WHEN COIL IS ENERGIZED, REGARDLESS OF RELATIVE POSITION OF COIL SYMBOL ON DRAWING.
VAR REF 5200A-1090 SHT 1
AC SENSE SIG (FROM ATTEN) 5200A-1080 SHT 1
P50 5200A-1010
OSC AMPL OUT
LIMIT
AMPTD 1
AMPTD 2
AMPTD 4
AMPTD 8
SENSE LOW
PCB SHIELD
BUFFER AMPLIFIER
RECTIFIER AMPLIFIER
HIGH FREQ GAIN
INT ZERO
AMPTD CONTROL
ZERO TO -15VDC
100 Hz DRIVE
64 OUTPUT LOW

FIGURE 8-11. (1 of 3) A8 AC-DC CONVERTER PCB ASSEMBLY (5200A-1050)



BUFFER AMPLIFIER

FIGURE 8-11 (2 of 3) A8 AC-DC CONVERTER PCB ASSEMBLY (5200A-1050)

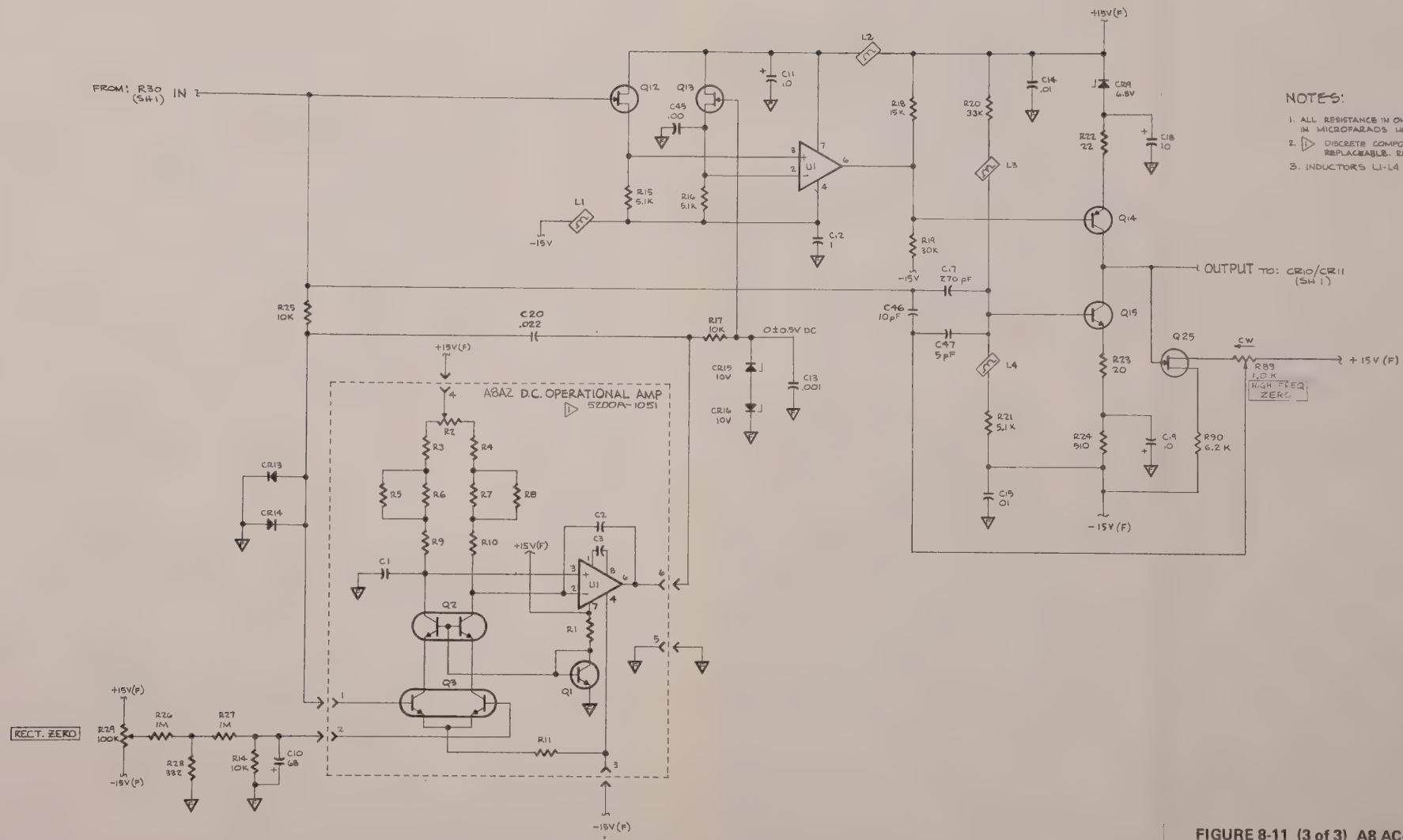


FIGURE 8-11 (3 of 3) A8 AC-DC CONVERTER PCB ASSEMBLY (5200A-1050)

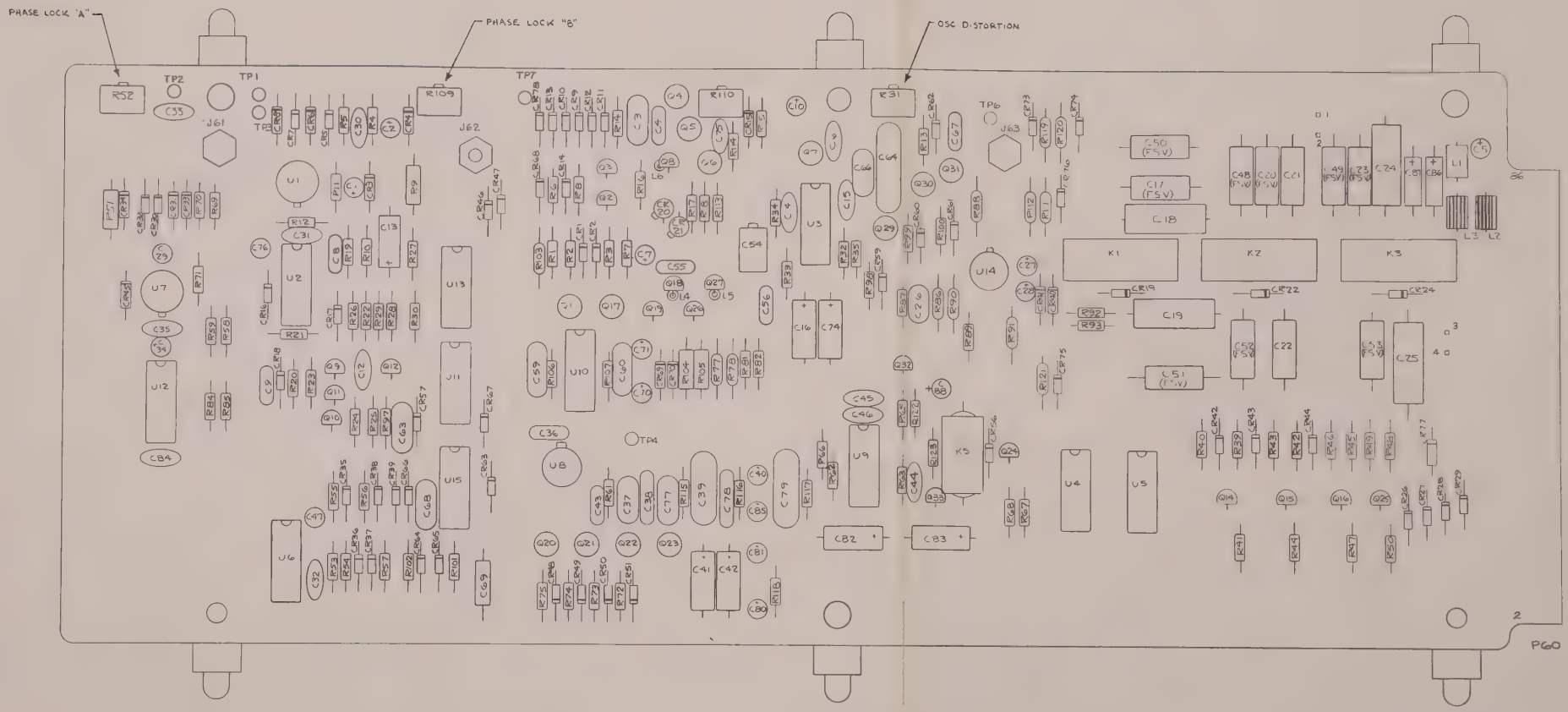
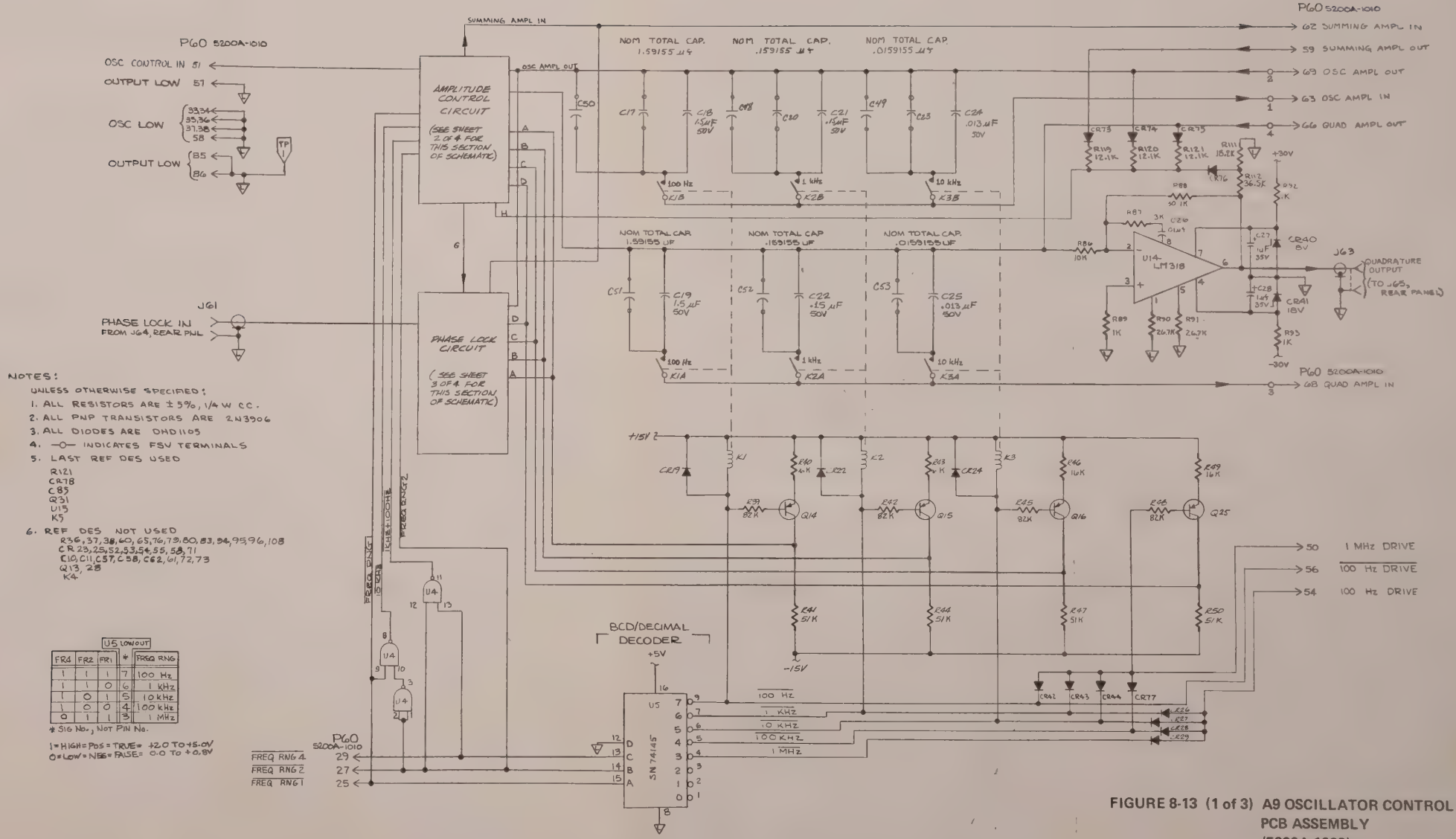


FIGURE 8-12 A9 OSCILLATOR CONTROL ASSY. COMPONENT LOCATION (5200A-1060)



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTORS ARE ±5%, 1/4 W CC.
2. ALL PNP TRANSISTORS ARE 2N3906
3. ALL DIODES ARE DHD1105
4. —O— INDICATES FSV TERMINALS
5. LAST REF DES USED
   - R121
   - CR78
   - C85
   - Q31
   - U15
   - K5
6. REF DES NOT USED
   - R36,37,38,60,65,76,79,80,83,94,95,96,108
   - CR23,25,52,53,54,55,58,71
   - C10,C11,C57,C58,C62,61,72,73
   - Q13, 28
   - K4

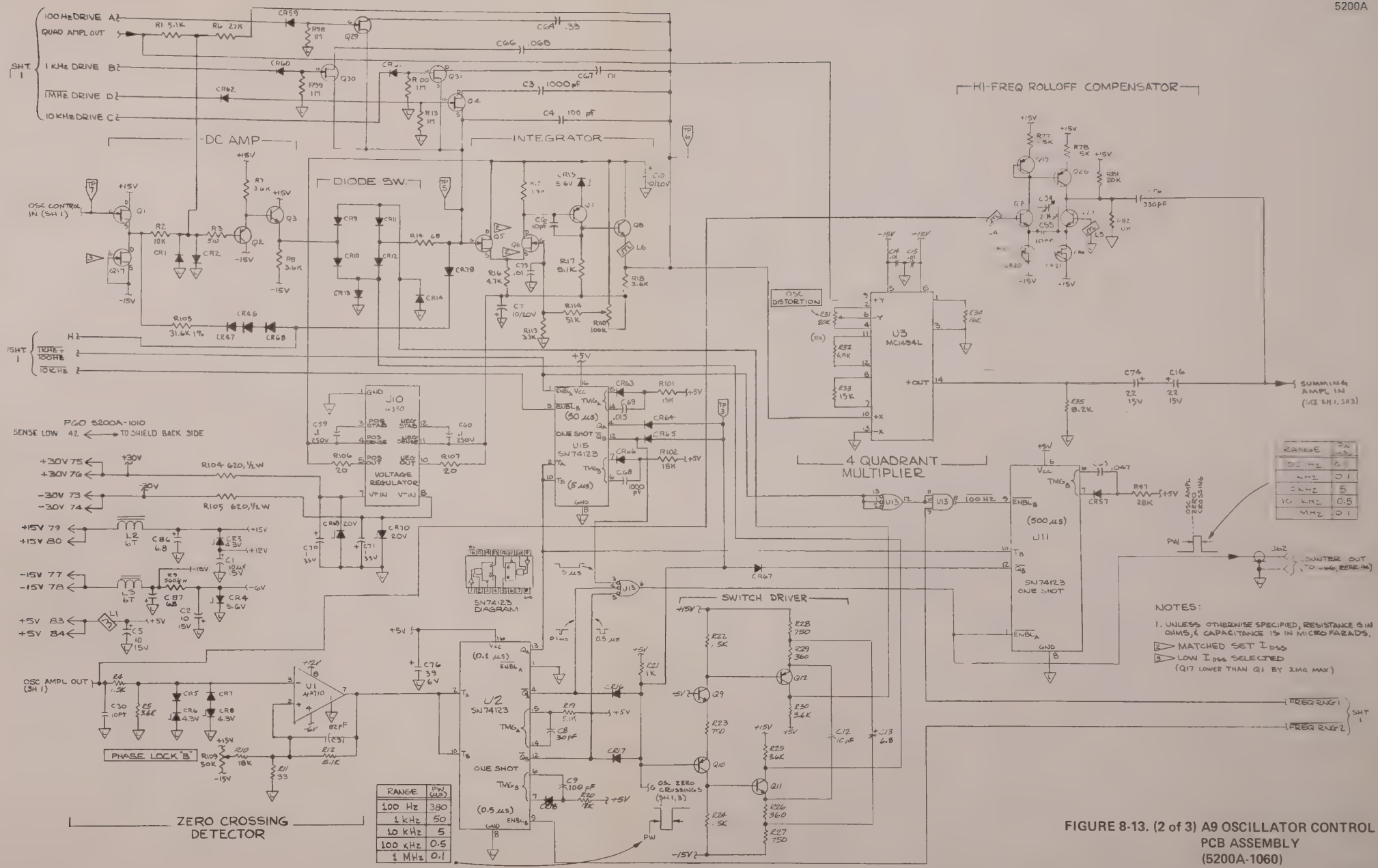
U5 LOW OUT

FR4	FR2	FR1	*	FREQ RNG
1	1	1	7	100 Hz
1	1	0	6	1 kHz
1	0	1	5	10 kHz
1	0	0	4	100 kHz
0	1	1	3	1 MHz

* SIG No., NOT PIN No.

1 = HIGH = POS = TRUE = +2.0 TO +5.0V
0 = LOW = NEG = FALSE = 0.0 TO +0.8V

FIGURE 8-13 (1 of 3) A9 OSCILLATOR CONTROL PCB ASSEMBLY (5200A-1060)



RANGE	PW µS
100 Hz	380
1 kHz	50
10 kHz	5
100 kHz	0.5
1 MHz	0.1

RANGE	SW
100 Hz	1
1 kHz	10
10 kHz	01
100 kHz	5
1 MHz	0.5
10 MHz	01

FIGURE 8-13. (2 of 3) A9 OSCILLATOR CONTROL PCB ASSEMBLY (5200A-1060)

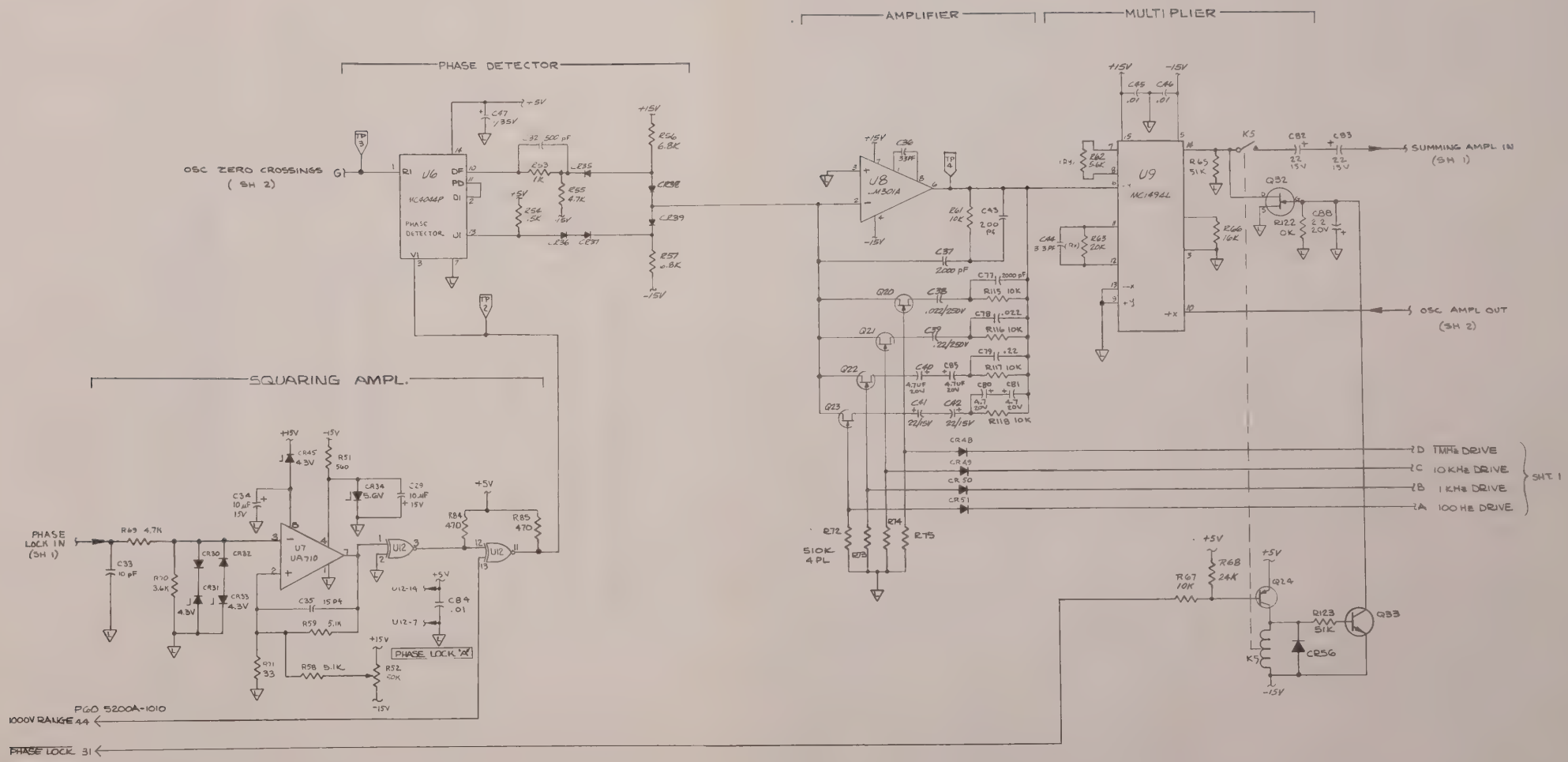


FIGURE 8-13 (3 of 3) A9 OSCILLATOR CONTROL PCB ASSEMBLY (5200A-1060)

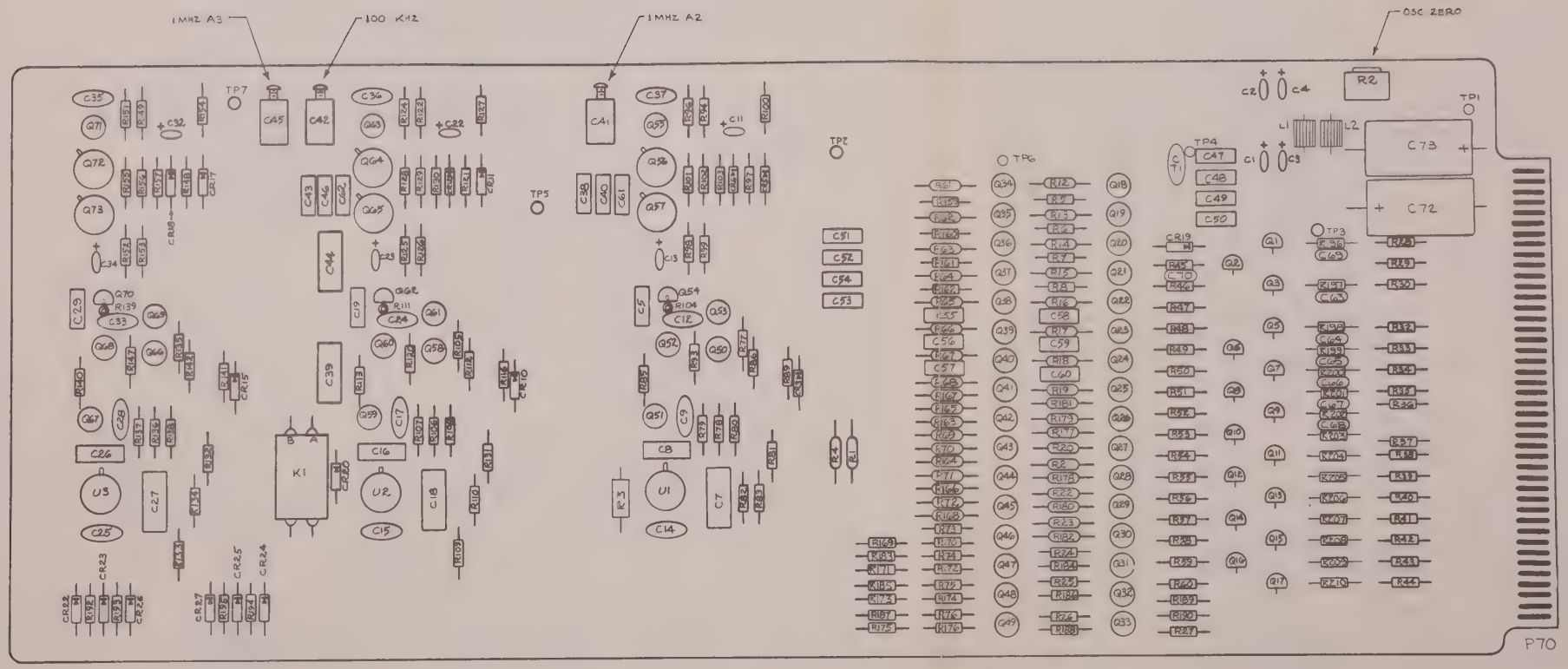


FIGURE 8-14 A10 OSCILLATOR ASSEMBLY
COMPONENT LOCATION
(5200A-1070)

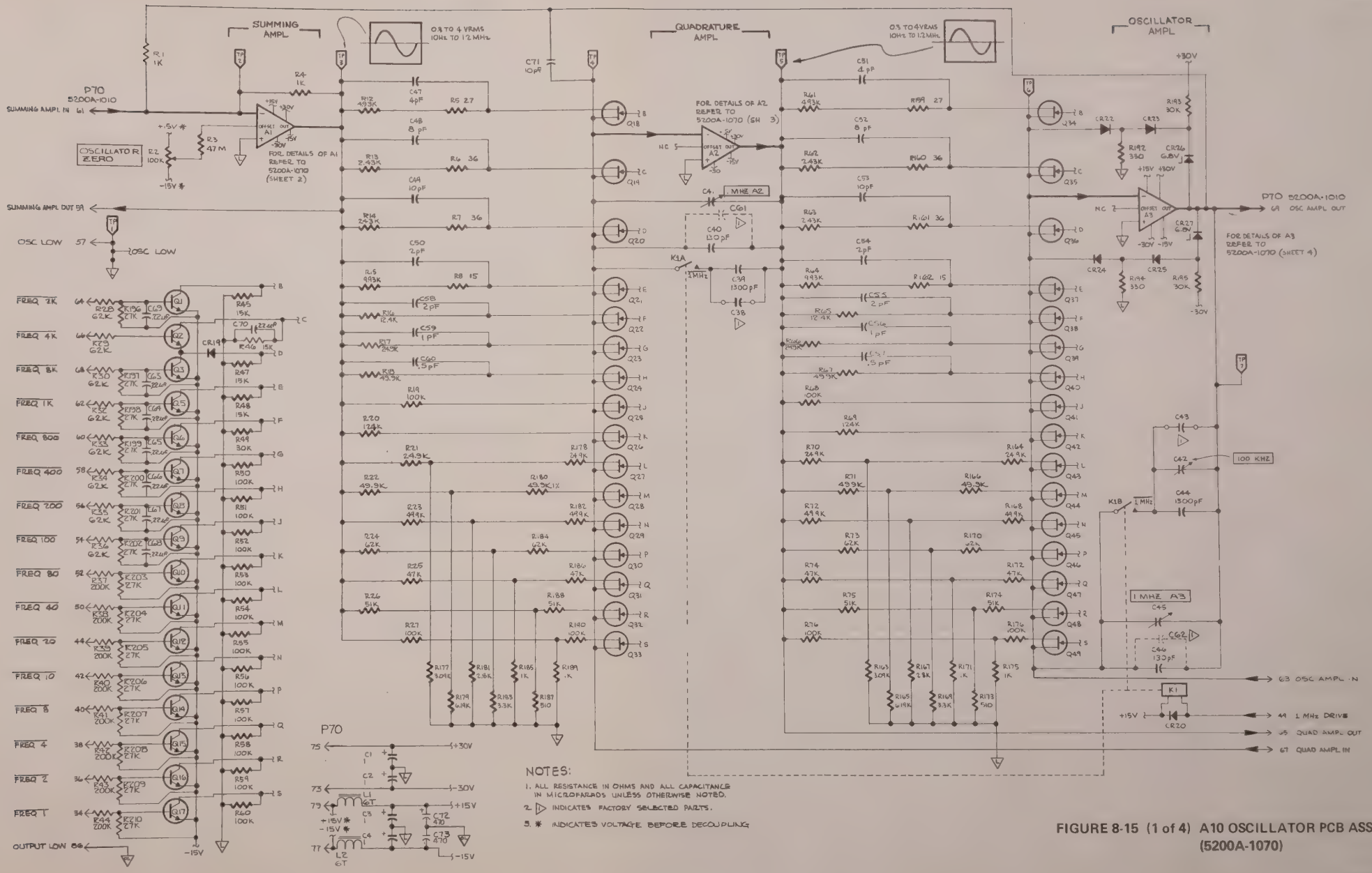
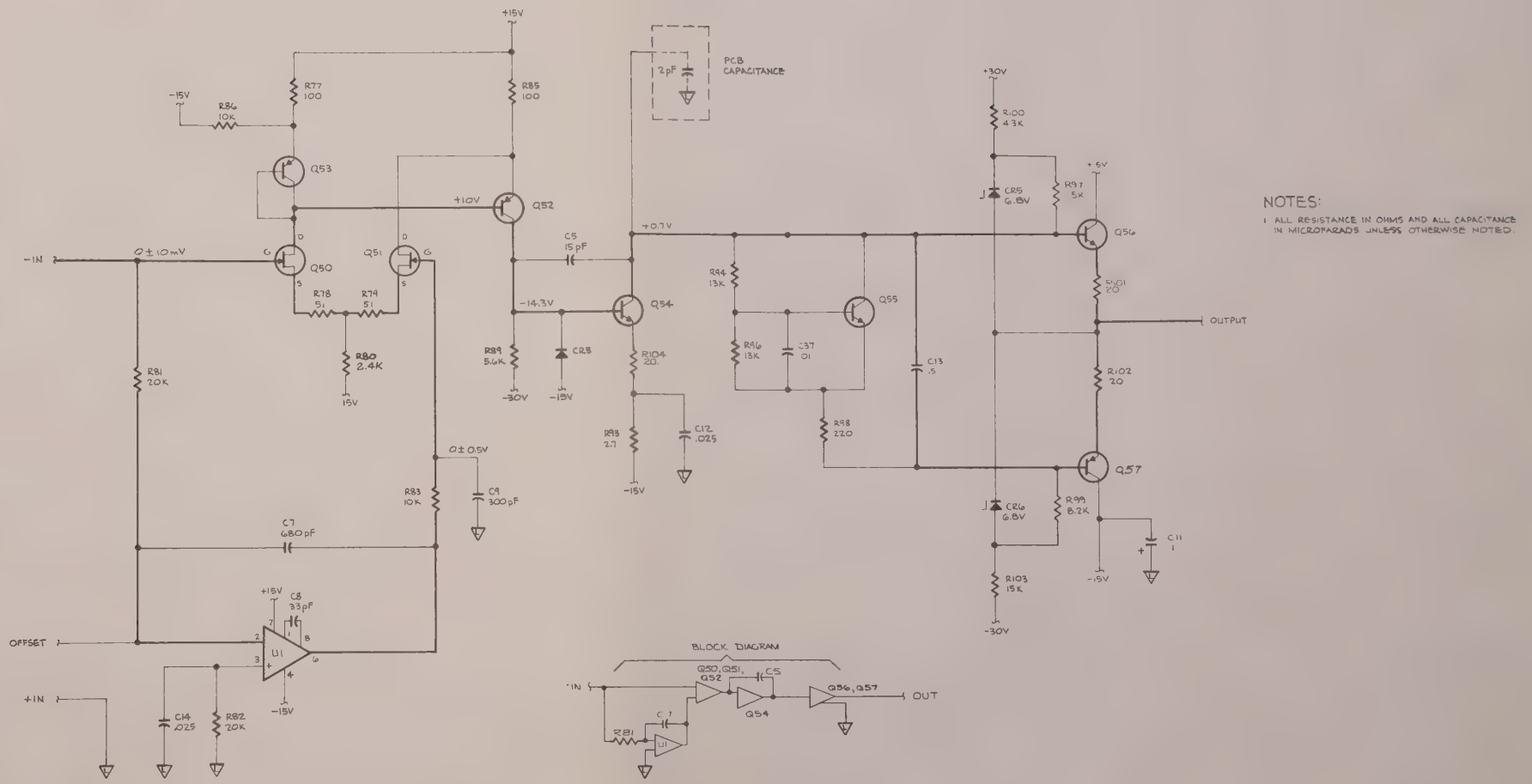
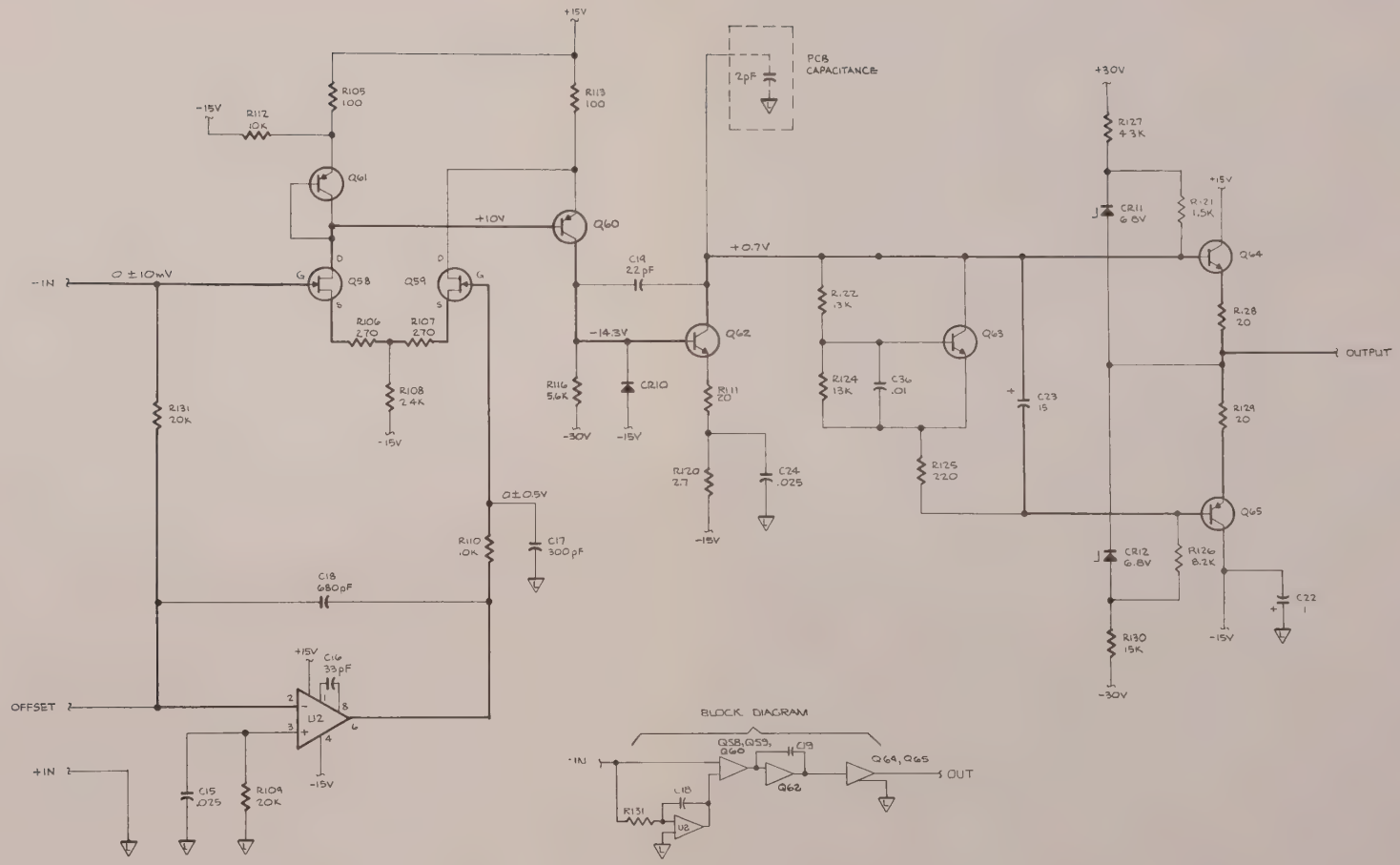


FIGURE 8-15 (1 of 4) A10 OSCILLATOR PCB ASSY. (5200A-1070)



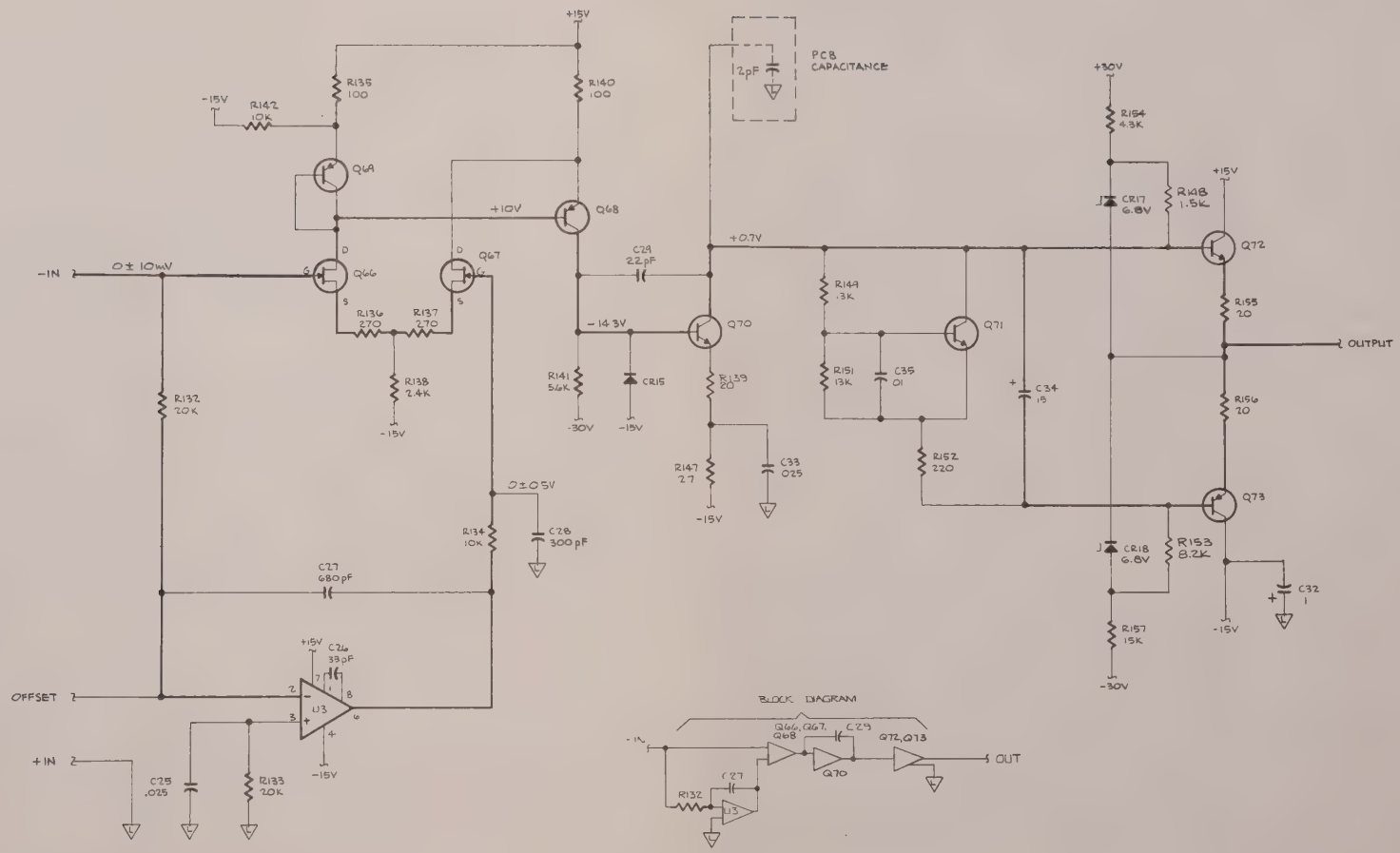
A10A1, SUMMING AMPLIFIER

FIGURE 8-15 (2 of 4) A10 OSCILLATOR PCB ASSY. (5200A-1070)



A10A2, QUADRATURE AMPLIFIER

FIGURE 8-15 (3 of 4) A10 OSCILLATOR PCB ASSY. (5200A-1070)



A10A3, OSCILLATOR AMPLIFIER

NOTES:

1. ALL RESISTANCE IN OHMS AND ALL CAPACITANCE IN MICROFARADS UNLESS OTHERWISE NOTED.

FIGURE 8-15 (4 of 4) A10 OSCILLATOR PCB ASSY. (5200A-1070)

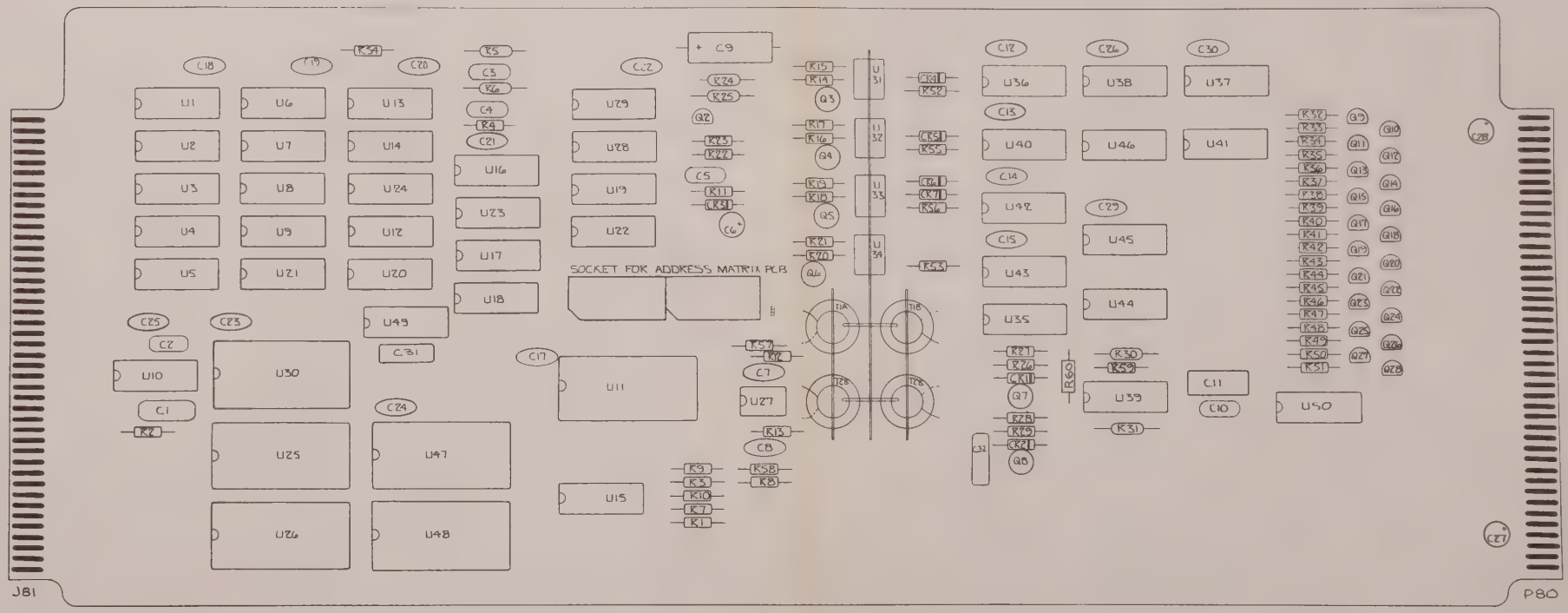


FIGURE 8-16. A11 REMOTE CONTROL UNIT ASSY. COMPONENT LOCATION (5200A-1080)

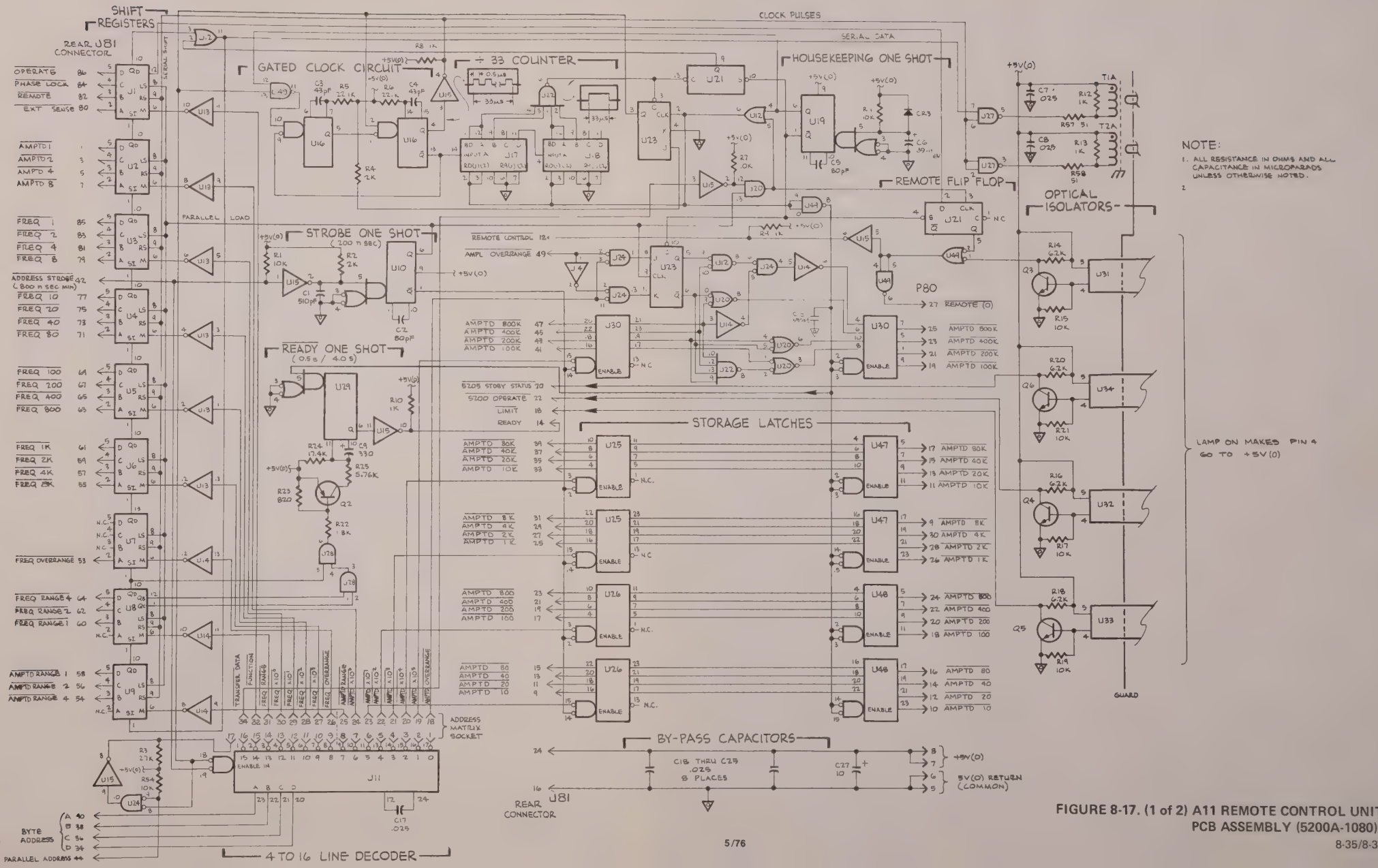


FIGURE 8-17. (1 of 2) A11 REMOTE CONTROL UNIT PCB ASSEMBLY (5200A-1080)

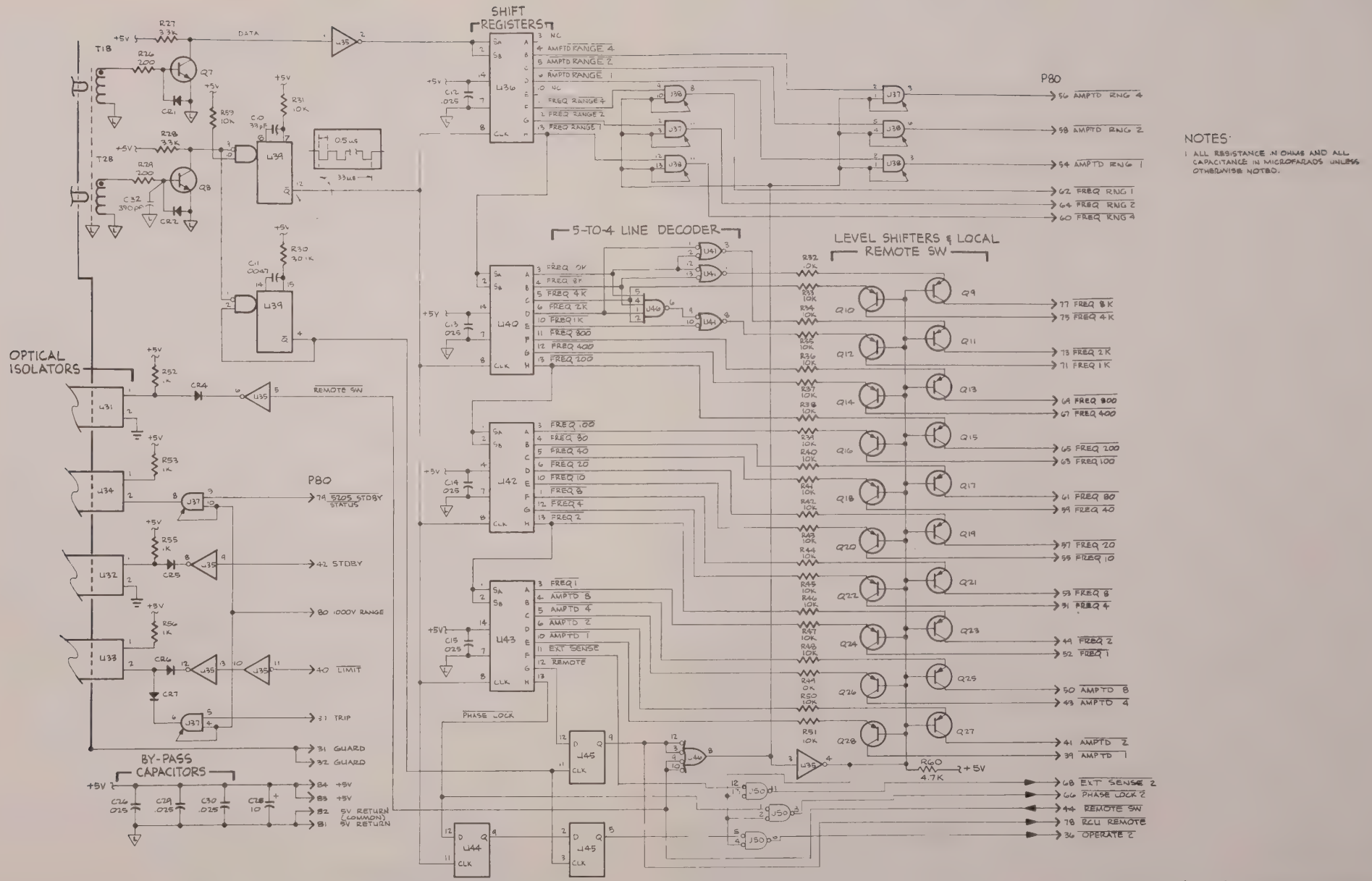


FIGURE 8-17. (2 of 2) A11 REMOTE CONTROL UNIT PCB ASSEMBLY (5200A-1080)

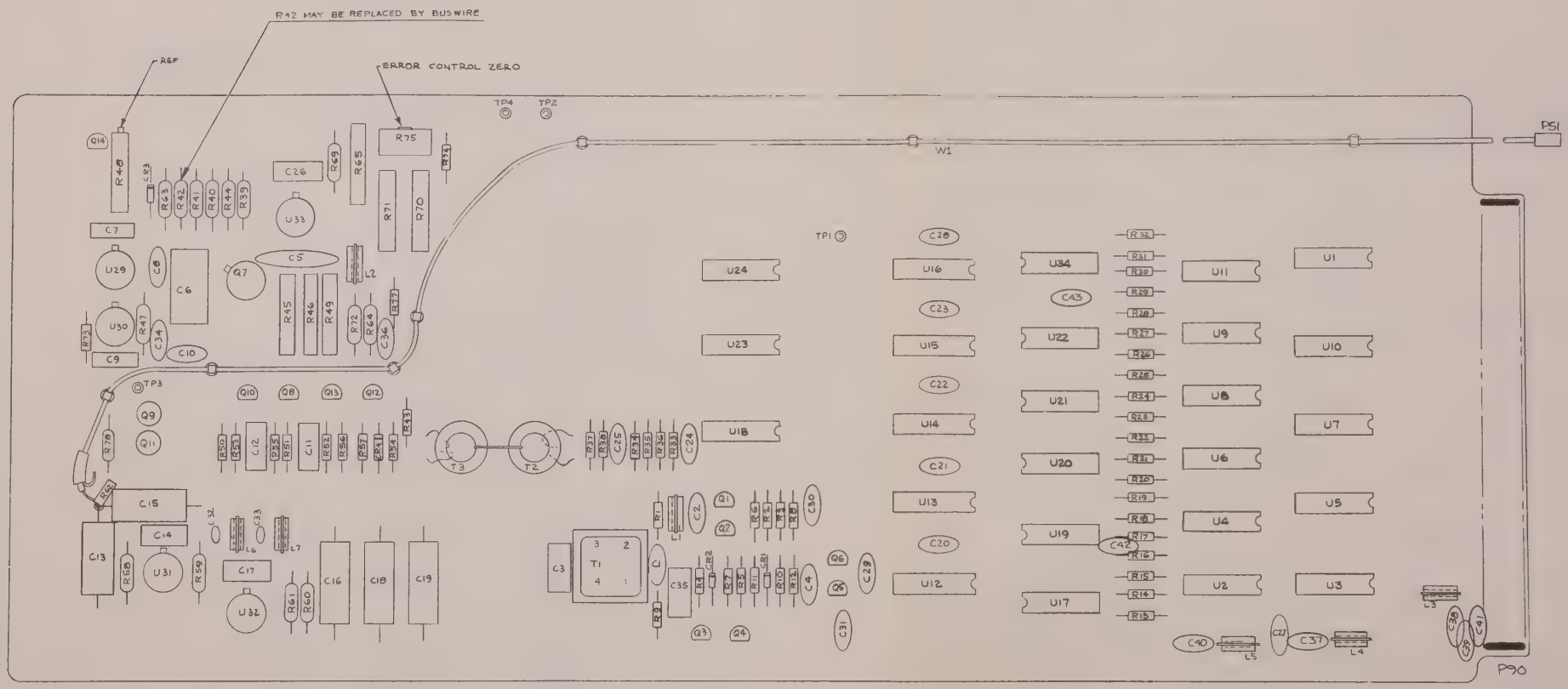
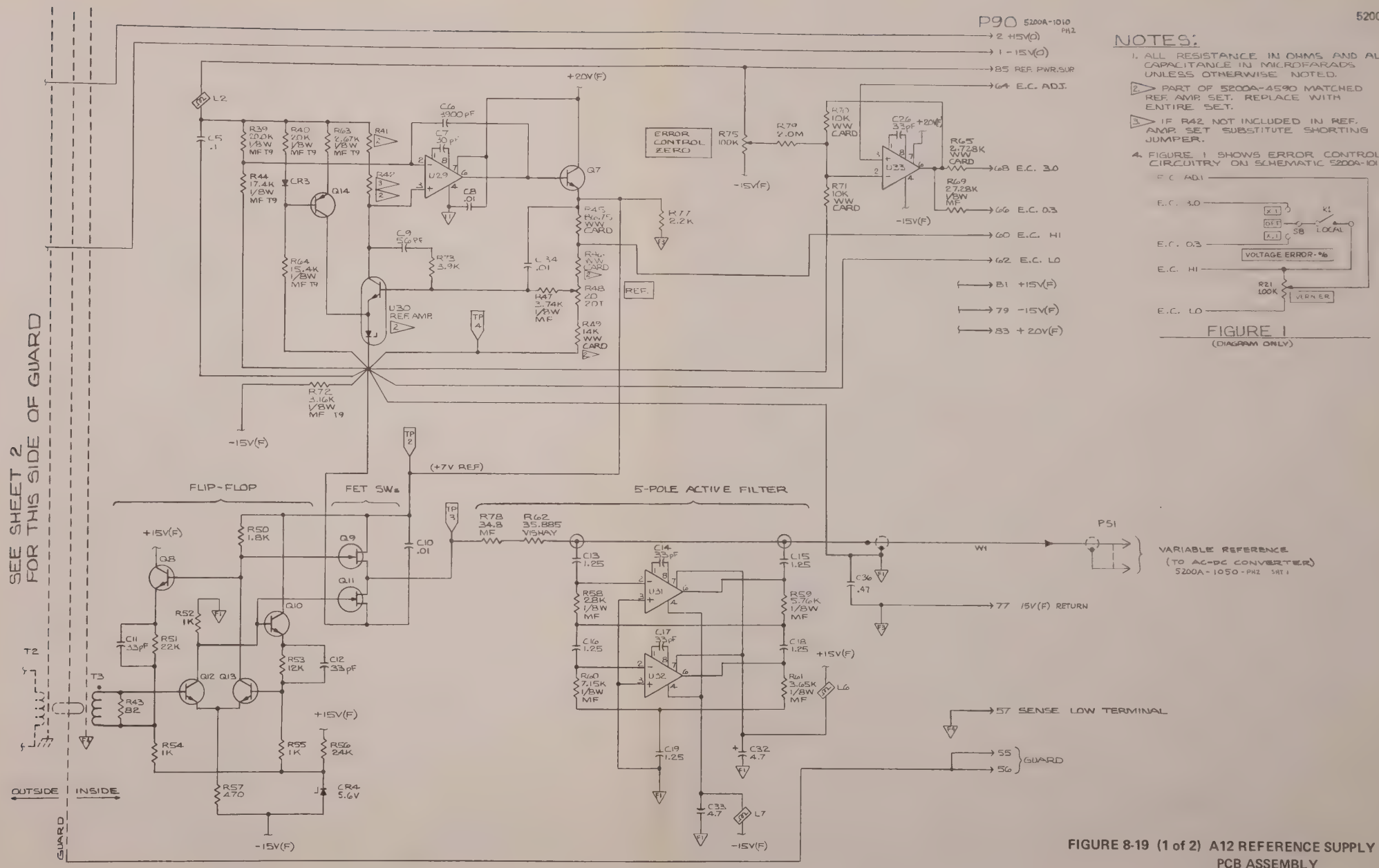


FIGURE 8-18 A12 REFERENCE SUPPLY ASSY.
COMPONENT LOCATION
(5200A-1090)



NOTES:

1. ALL RESISTANCE IN OHMS AND ALL CAPACITANCE IN MICROFARADS UNLESS OTHERWISE NOTED.
2. PART OF 5200A-4590 MATCHED REF. AMP. SET. REPLACE WITH ENTIRE SET.
3. IF R42 NOT INCLUDED IN REF. AMP. SET SUBSTITUTE SHORTING JUMPER.
4. FIGURE 1 SHOWS ERROR CONTROL CIRCUITRY ON SCHEMATIC 5200A-1011.

FIGURE 1
(DIAGRAM ONLY)

FIGURE 8-19 (1 of 2) A12 REFERENCE SUPPLY PCB ASSEMBLY (5200A-1090)

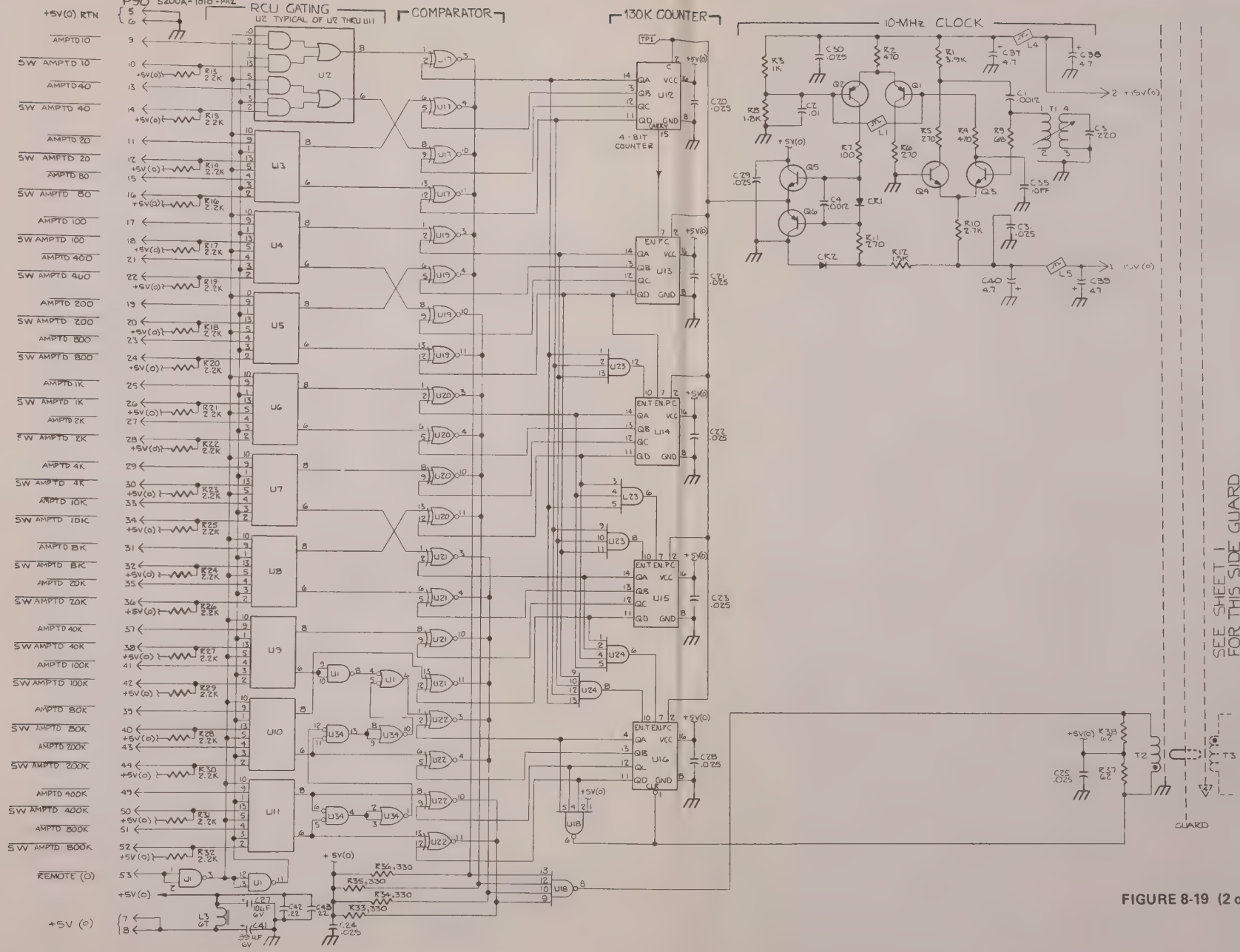


FIGURE 8-19 (2 of 2) A12 REFERENCE SUPPLY PCB ASSEMBLY (5200A-1090)

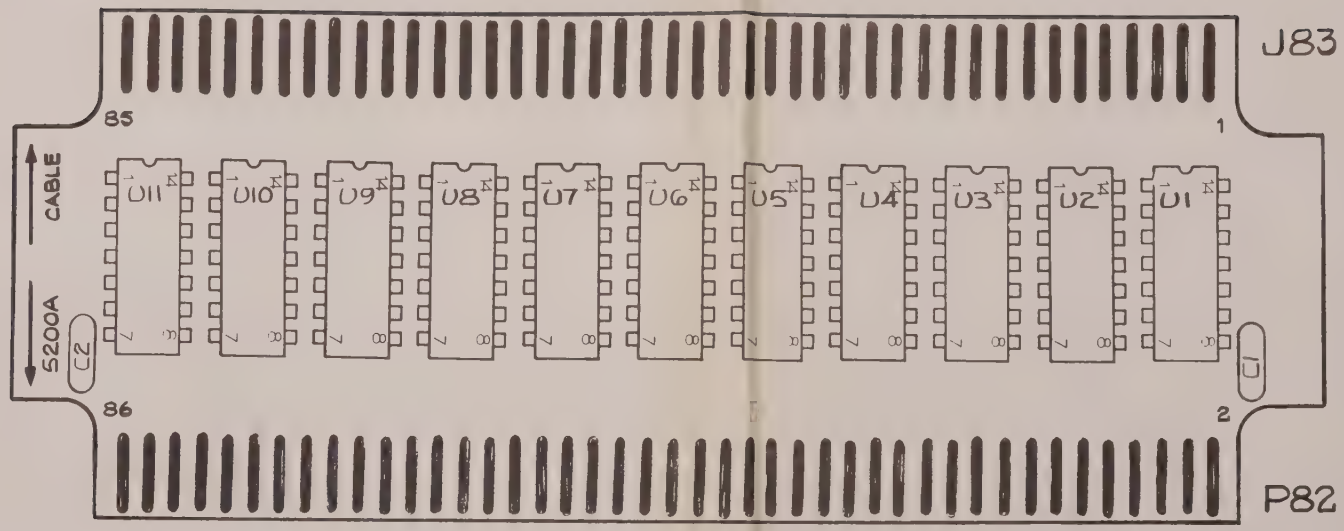
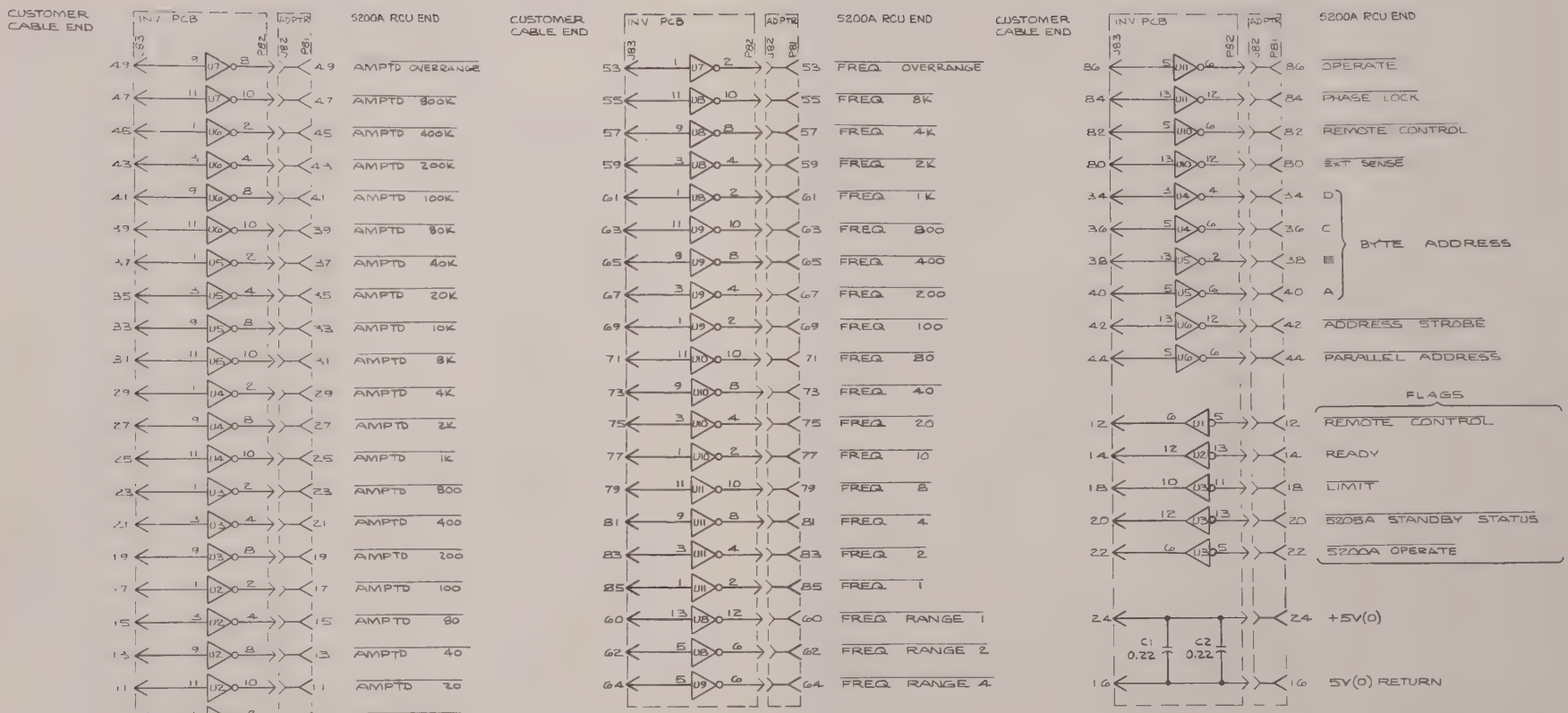


FIGURE 8-20 INVERTER ASSEMBLY COMPONENT LOCATION (5200A-1081)



NOTES:

1. PIN 14 ON U1 THRU U11 CONNECTED TO +5V(D).
2. PIN 7 ON U1 THRU U11 CONNECTED TO 5V(D) RETURN.
3. CAPACITANCE IN MICRO FARADES.
4. IC U1 THRU U11 ARE MC836P OR EQUIVALENT.
5. LAST REFERENCE DESIGNATORS USED:
   C2
   U11
6. SEE SHEET 2 FOR REFERENCE DESIGNATORS.
7. J83 MATES WITH CUSTOMER INTERFACE CABLE. P81 MATES WITH J81 ON 5200A RCU.

FIGURE 8-21 INVERTER PCB ASSEMBLY (5200A-1081)

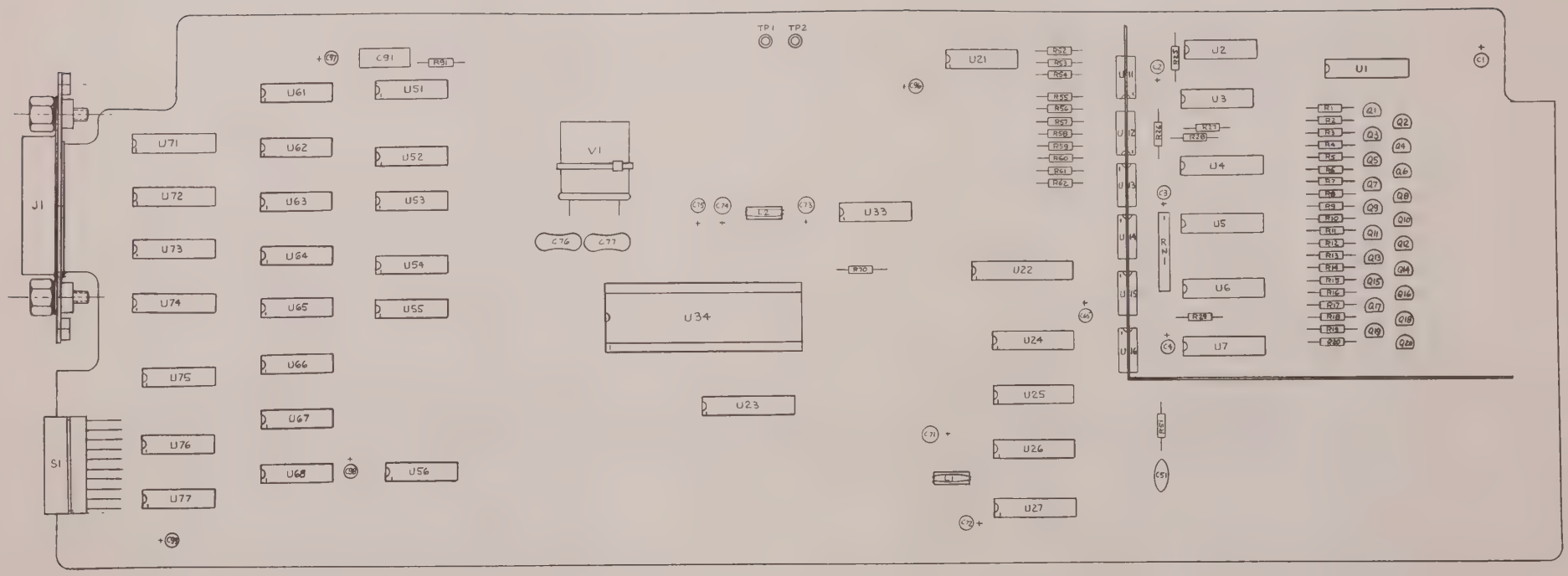


FIGURE 8-22 IEEE INTERFACE (I/F) ASSEMBLY
COMPONENT LOCATION
(5200A-1686)

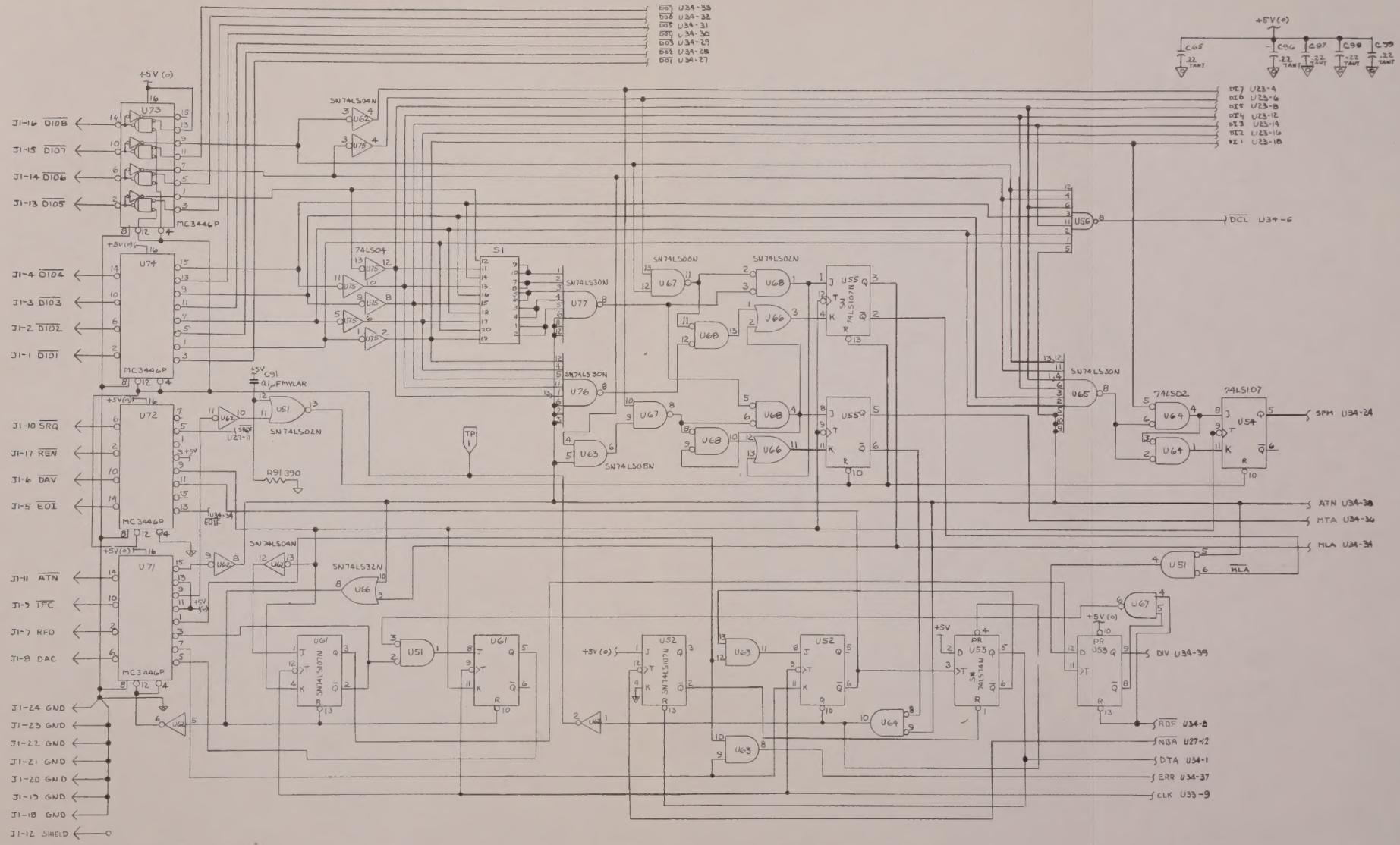


FIGURE 8-23 (1 of 2) IEEE INTERFACE (I/F) ASSEMBLY
(5200A-1086)

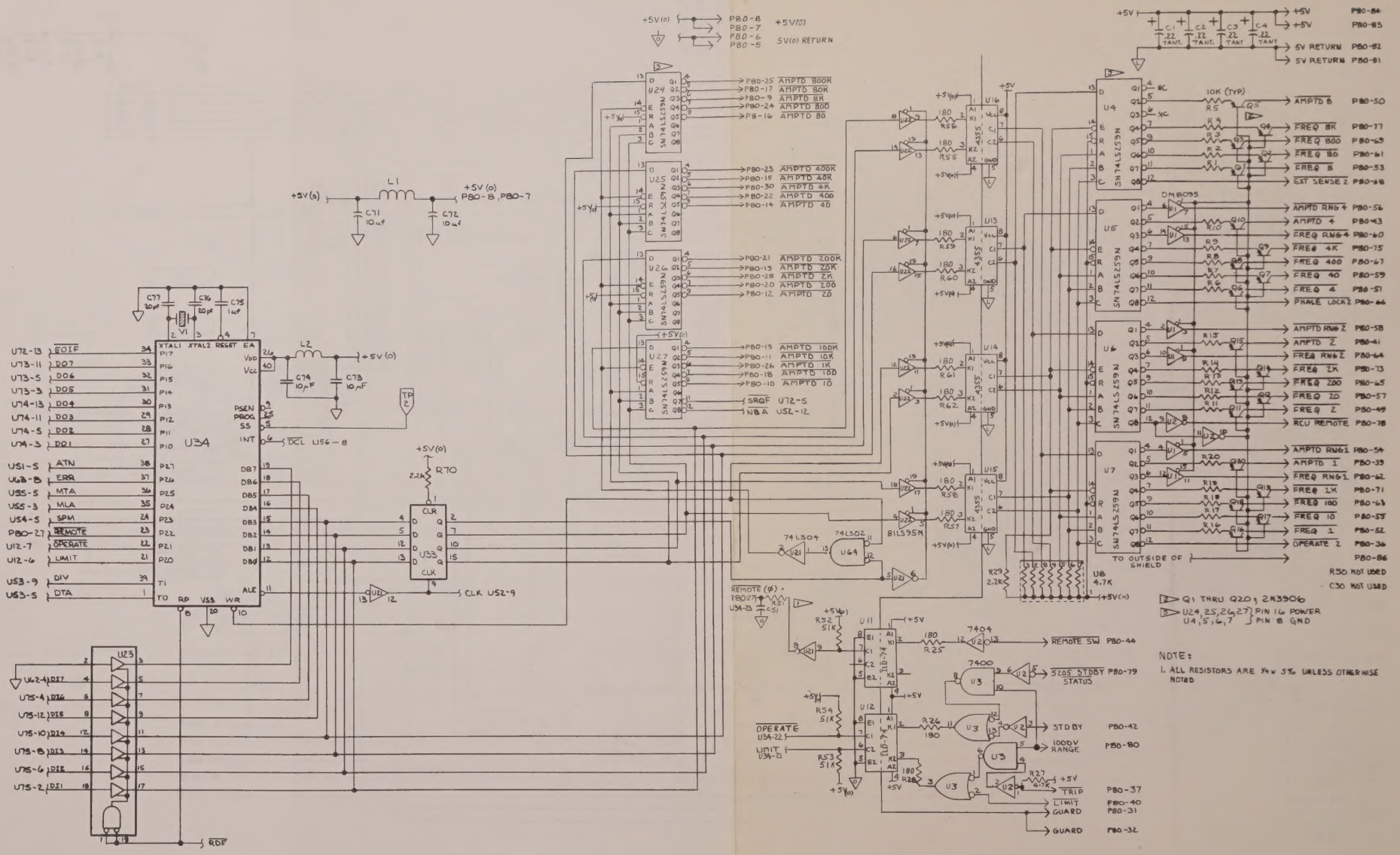


FIGURE 8-24 (2 of 2) IEEE INTERFACE (I/F) ASSEMBLY
(5200A-1086)